CP 100™ 12-Lead Resting Electrocardiograph

Directions for Use

Welch Allyn®

Advancing Frontline Care™

Caution: Federal US law restricts sale of the device identified in this manual to, or on the order of, a licensed physician.

Welch Allyn assumes no responsibility for any injury, or for any illegal or improper use of the product, that may result from failure to use this product in accordance with the instructions, cautions, warnings, or indications for use published in this manual.

For information about any Welch Allyn product, please call Welch Allyn Technical Support:

USA	1 800 535 6663 + 1 315 685 4560	Australia	+ 61 29 638 3000
Canada	1 800 561 8797	China	+ 86 216 327 9631
European Call Center	+ 353 46 906 7790	France	+ 331 6009 3366
Germany	+ 49 747 792 7186	Japan	+ 81 33 219 0071
Latin America	+ 1 305 669 9003	Netherlands	+ 31 15 750 5000
Singapore	+ 65 6419 8100	South Africa	+ 27 11 777 7555
United Kingdom	+ 44 207 365 6780	Sweden	+ 46 85 853 6551

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1 Introduction

About This Manual

This manual is written for clinical professionals with a working knowledge of medical procedures and terminology as required for monitoring cardiac patients.

Before using the CP 100 electrocardiograph for clinical applications—or before setting up, configuring, troubleshooting, or servicing the electrocardiograph—you must read and understand this manual and all other information accompanying the electrocardiograph and related options or accessories.

Product Overview

The Welch Allyn CP 100 electrocardiograph features a full alphanumeric keyboard, an LCD display, full-size user-programmable reports, and the ability to operate on either battery or AC power.

ECG tests sent to a memory card or removable USB storage device are compatible with the Welch Allyn CardioPerfect™ workstation, which in turn can connect with other electronic patient-information systems, such as billing and medical records.

For details, see the following sections:

- "Standard Features & Benefits" on page 3
- "Options" on page 5
- "Specifications" on page 73

Intended Use

The Welch Allyn electrocardiography and spirometry products (subject devices) are intended for use by trained operators in health facilities. The subject devices provide the following diagnostic functions:

- Acquiring and printing ECG waveforms using ECG front end modules (patient cables) and associated accessories that provide signal acquisition for up to twelve (12) leads of patient ECG waveforms through surface electrodes adhered to the body.
- Using optional algorithms to generate measurements, data presentations, graphical presentations and interpretative statements on an advisory basis. These are presented for review and interpretation by the clinician based upon knowledge of the patient, the result of physical examination, the ECG tracings and other clinical findings.

Indications for Use

The electrocardiograph is one of the tools that clinicians use to evaluate, diagnose, and monitor patient cardiac function.

The 12-lead ECG interpretive algorithm provides a computer-generated analysis of potential patient cardiac abnormalities which must be confirmed by a physician with other relevant clinical information.

Standard Features & Benefits

Full alphanumeric keypad
Enter patient information quickly and easily.

LCD display
Enter data and program the system easily.

Unlimited storage on removable media
Use SD™ memory cards or removable USB storage devices to save as many ECG records as you like. (Media are not included.) If both an SD memory card and a USB storage device are connected, files are sent to the SD card. For media specifications, see "Standard connectivity" on page 74.

Battery operation
Use the electrocardiograph almost anywhere. On battery power, you can print up to 100 ECGs continuously before needing to recharge.

User-definable ECG report format
Customize the report format for efficient reporting.

Removable leads for ECG patient cable
Replace leads individually if needed.

Compatibility with CardioPerfect workstation software
Store and manage data electronically by transferring records to a Welch Allyn CardioPerfect workstation via an SD memory card or removable USB storage device (media not included).

Compatibility with external printer
You can connect an external printer. For details, see "Connecting an External USB Printer (Optional)" on page 24.

Pacemaker detection
If the software detects the possible presence of a pacemaker, it asks you whether the patient has a pacemaker. If you say no, interpretation (if purchased) is included in the report. If you say yes, interpretation is not included in the report, and a message indicating that a pacemaker was detected is displayed on the report.

Support for augmented pediatric lead set
The augmented pediatric lead set, an alternate placement of the precordial leads on pediatric patients, is easier to use on the small chests of infants and young children. It provides optimal vectors for early development of the heart for the change of right-to-left ventricular dominance. For electrode placement locations, see *Figure 28* on page 46.

Options

These options are available both for initial purchases and for upgrades.

- **Automatic ECG interpretation**

  The optional MEANS interpretation algorithm, developed by the University of Rotterdam in the Netherlands, provides automatic analysis of ECG tests. For more information, see the *MEANS Physicians' Manual* or the *PEDMEANS Physicians' Manual* on the CD that came with your electrocardiograph. The MEANS algorithm is used for adult patients 18 years and older. The PEDMEANS algorithm is used for pediatric patients from 1 day through 17 years old.

- **Carts**

  Two specially designed carts are available for convenient transport and use of the electrocardiograph, as shown here with the optional cable arm and shelf.

Figure 1. Office Cart

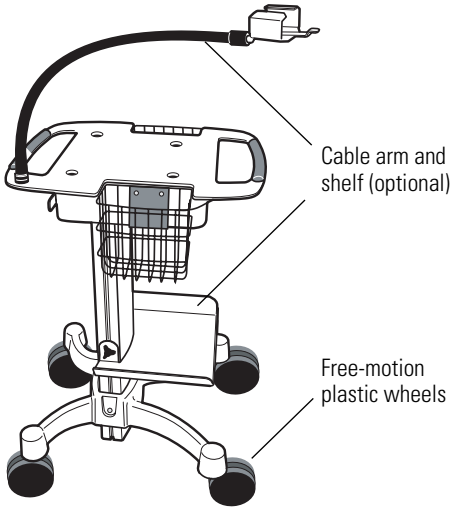
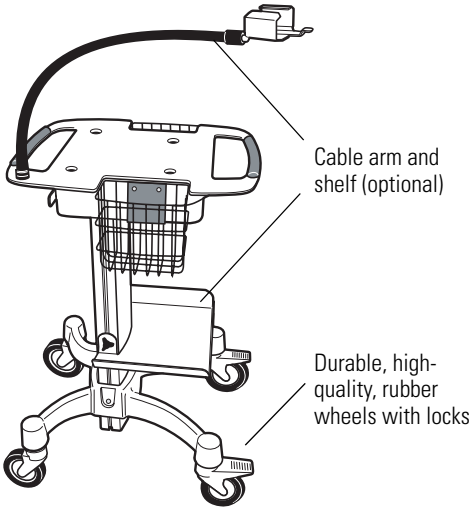


Figure 2. Hospital Cart



Accessories

To order accessories, call Welch Allyn. For phone numbers, see page ii.

Item	Customer Order Number	Quantity
Resting tab electrodes	45008-0000	1000
Resting tab electrode adaptors	58581-0000	10
Thermal chart paper (1 case = 5 pads, 200 sheets each)	94018-0000	1 case
Welch cup	RE-ELEC-CUP	1
Limb lead clamps, IEC	RE-ELEC-CLP	4
Limb lead clamps, AHA	401432	4
Patient cable (Figure 11 on page 12)		
• AHA	400293	1
• IEC	400294	1
• IEC, vacuum adapter	100920	1
• Vacuum system	VAC-DT100-CP	
Lead wires (10 wires per set)		
• AHA banana	401129	1 set
• IEC banana	401122	1 set
• AHA pinch	401123	1 set
• IEC pinch	401124	1 set
Battery (Figure 39 on page 61)	100660	1
Dust cover	701586	1
Carts		
• Utility cart	08265-0000	1
• Office cart (Figure 1 on page 5)	401393	1
• Hospital cart (Figure 2 on page 5)	401394	1
• Cable arm & shelf option (page 5)	401161	1
Interpretation upgrade option	100623	1
Product information		
• Electrode placement wall poster	71300-0000	1
• *CP 100 12-Lead Resting Electrocardiograph Directions for Use*	708794	1
• CP 100 product information multi-language CD	401150	1

Controls, Indicators, and Connectors

This section describes the controls, indicators, and connectors that are part of the electrocardiograph.

Figure 3. Top

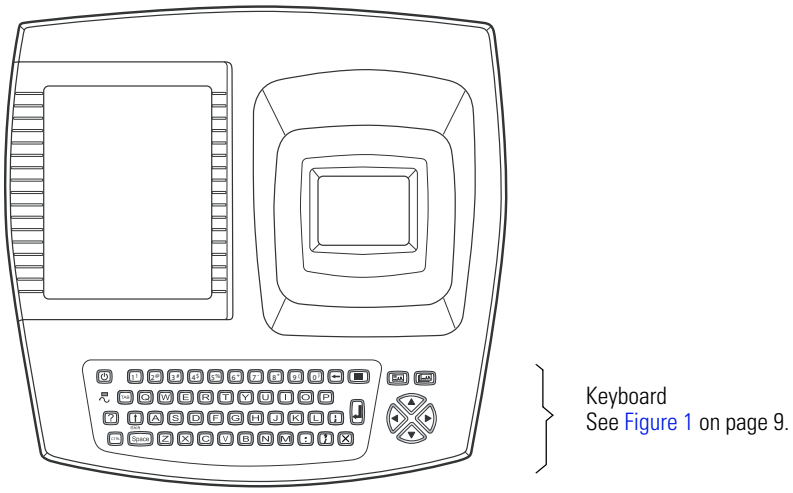


Figure 4. Back

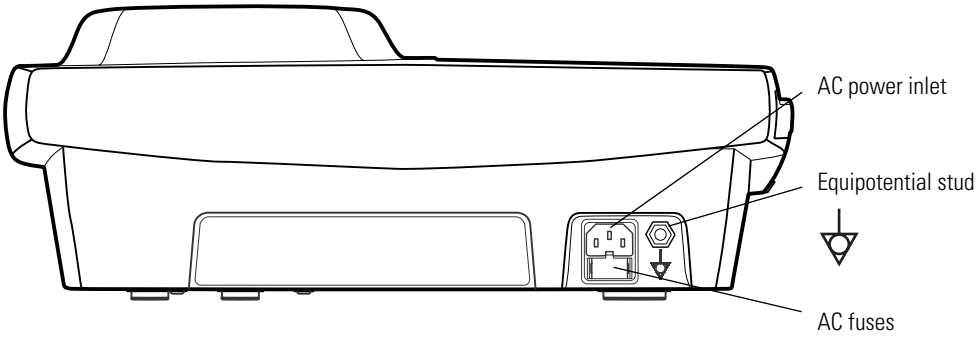


Figure 5. Right Side

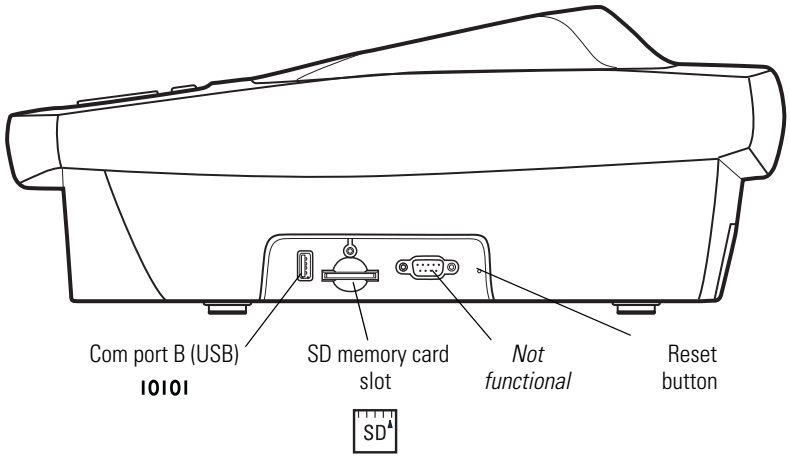


Figure 6. Front

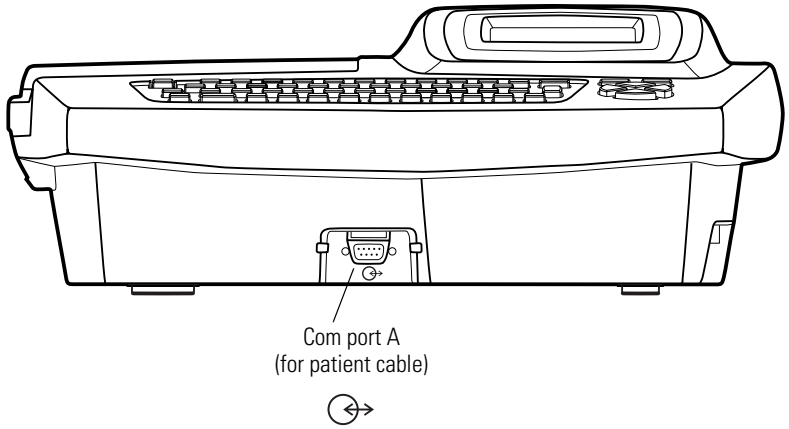


Figure 7. Left Side

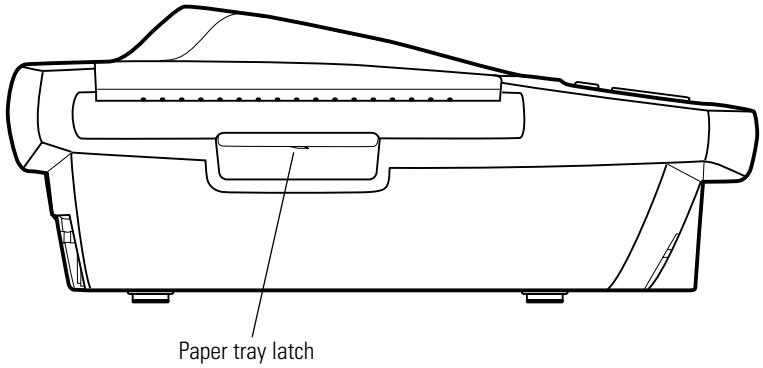
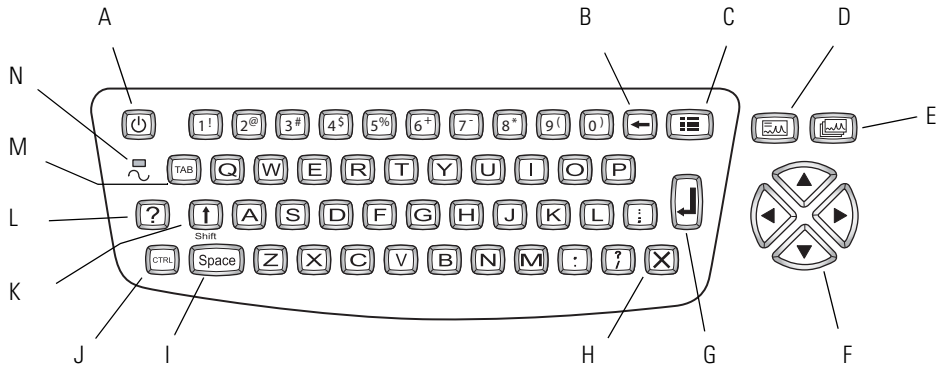


Table 1. Keyboard

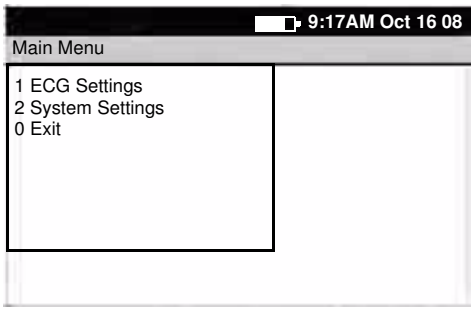


Key	Function
A. On/Off	See "Powering the Electrocardiograph" on page 22.
B. Backspace	Deletes the character to the left of the cursor.
C. Menu	See "About the Main Menu" on page 10.
D. Auto ECG	Begins Auto ECGs, normal and stat. See "Recording an Auto ECG" on page 48.
E. Rhythm ECG	Begins a Rhythm ECG. See "Recording a Rhythm ECG" on page 54.
F. Navigation arrows	See "Moving Through the Menus" on page 11.
G. Enter	See "Moving Through the Menus" on page 11.
H. Stop/Cancel	Stops any current activity. See "Moving Through the Menus" on page 11.
I. Space	Enters a space.
J. Control	(Applicable only for keyboards with characters above certain keys.) To enter a character above a key, hold the **Ctrl** key while pressing that key. To capitalize the character, hold **Shift** + **Ctrl** while pressing the key.
K. Shift	Capitalizes letters. Also enters symbols (%, #, etc.). To enter a symbol, hold the **Shift** key while pressing a number key.
L. Help	See "Getting Help" on page 18.
M. Tab	Moves through the data-entry fields.
N. Green LED	Lights up when the electrocardiograph is connected to AC power.

About the Main Menu

The main menu appears when you press the Menu key .

Figure 8. Main Menu



Submenu	Purpose	Procedure
ECG Settings	Review or change ECG settings: Auto Report format, Rhythm Report format, and so on.	See "Reviewing the ECG Settings" on page 31.
System Settings	Review or change system settings: device configuration, device info, user setup, and so on.	See "Reviewing the System Settings" on page 25.

Moving Through the Menus

Figure 9. Standard Menu

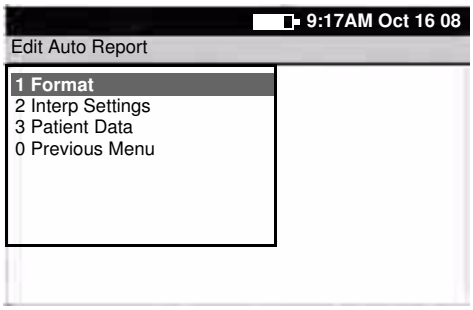
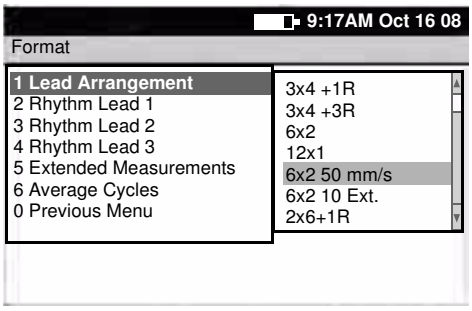


Figure 10. Parent Menu With Submenu

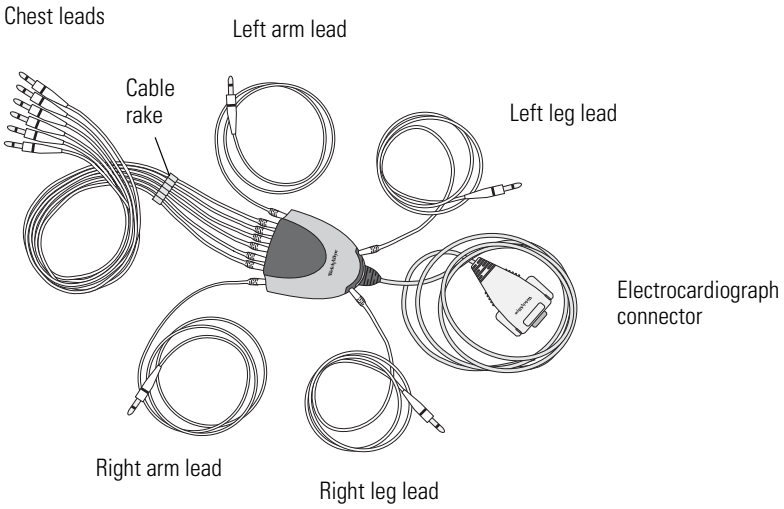


Desired Actions	Keys to Press
To move up or down a list	▲ or ▼
To open a standard menu (Figure 9) To move from parent menu to submenu on same screen (Figure 10)	↵ or ▶ or item's number or letter
To perform an action To accept data To check or uncheck a checkbox	↵
To return to parent menu from submenu on same screen (Figure 10)	↵ (To select the highlighted submenu item.) ✕ or ◀ (To make no change.)
To move back through the menus	◀ or zero key
To move through data-entry fields	TAB or ↵
To return to the **Ready** screen from a standard menu (Figure 9)	✕

About the Patient Cable and Leads

The patient cable processes the patient's ECG data and transmits it to the electrocardiograph. To make handling convenient, the ten leads are arranged to point toward the appropriate parts of the body. The cable rake, which slides easily, prevents the chest leads from tangling.

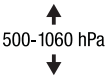
Figure 11. Patient Cable and Leads



Symbols

The symbols illustrated on the following pages may appear on the electrocardiograph, on the packaging, on the shipping container, or in this manual.

Documentation Symbols	
	**WARNING** Indicates conditions or practices that could lead to illness, injury, or death.
	**Caution** In this manual, indicates conditions or practices that could damage the equipment or other property.
	**Caution** On the product, means "Consult accompanying documentation."

Shipping, Storing, and Environment Symbols			
	This end up		Keep dry
	Fragile		Relative humidity limit
	Temperature limits		Altitude limits

Certification Symbols			
CE 0297	Meets essential requirements of European Medical Device Directive 93/42/EEC		Complies with applicable U.S. and Canadian medical safety standards
EC REP	European Regulatory Manager		Australian registered importer

Operation Symbols

For details on the keys, see Figure 1 on page 9.

	On/standby (off)		Help
	Navigation arrows		Backspace
	Enter		Shift
	Auto ECG		Menu
	Rhythm ECG		Stop/Cancel
	SD memory card slot		Com port A (for patient cable)
	Alternating current		Battery charge level
	Battery is charging.		Battery is charged.
	Dangerous voltage		Direct current
	AC fuse replacement information		Ground equipotential
	Do not reuse.		Sealed lead-acid battery
	Do not dispose of this product as unsorted municipal waste. Prepare this product for reuse or separate collection as specified by Directive 2002/96/EC of the European Parliament and the Council of the European Union on Waste Electronic and Electrical Equipment (WEEE). If this product is contaminated, this directive does not apply. For more specific disposal information, see www.welchallyn.com/weee, or contact Welch Allyn Customer Service at +44 207 365 6780.		Recycle.
			Defibrillation-proof Type CF applied parts. (While the electrocardiograph is safety-rated "CF" for direct cardiac contact, it is not intended to be connected directly to the patient's heart. Only surface contact with the patient's skin is intended.)
			Com port B (USB)

Using the Electrocardiograph Safely

Before using or servicing the electrocardiograph, you must read and understand the following safety-related information.

General Warnings

The following warning statements apply to electrocardiograph use in general. Warning statements that apply specifically to particular procedures, such as connecting the patient cable or performing an ECG test, appear in the corresponding sections of the manual.

Warning statements indicate conditions or practices that could lead to illness, injury, or death.

Warnings Related to the Environment

WARNING To ensure patient and device safety, leave 5 feet (1.5 meters) of open area around the patient.

WARNING To avoid a possible explosion, do not use the electrocardiograph in the presence of flammable anesthetics: mixtures containing air, oxygen, or nitrous oxide.

WARNING When transporting the electrocardiograph on a cart, tuck the patient cable away from the wheels so that it does not present a hazard.

Warnings Related to Accessories and Other Equipment

WARNING For operator and patient safety, peripheral equipment and accessories that can come in direct patient contact must be in compliance with all appropriate safety, EMC, and regulatory requirements. See "EMC Guidance and Manufacturer's Declarations" on page 75.

WARNING All signal input and output (I/O) connectors are intended for connection of only devices complying with IEC 60601-1, or other IEC standards (for example, IEC 60950), as appropriate to the device. Connecting additional devices to the electrocardiograph might increase chassis or patient leakage currents. To maintain operator and patient safety, consider the requirements of IEC 60601-1-1. Measure the leakage currents to confirm that no electric shock hazard exists. In the case of a USB printer, the printer (non-medical electrical equipment) shall be situated outside the patient environment (reference IEC 60601-1-1). The printer used should be approved to the appropriate safety standard for non-medical electrical equipment (IEC 60950, or its national variants), and use of an isolation transformer is recommended. If there is a requirement for the printer to be situated within the patient environment it is the responsibility of the user to ensure that the system provides a level of safety in compliance with IEC 60601-1 and 60601-1-1.

WARNING The electrocardiograph has not been designed for use with high-frequency (HF) surgical equipment and does not protect against hazards to the patient.

Warnings Related to Using the Electrocardiograph

WARNING This device captures and presents data reflecting a patient's physiological condition. When reviewed by a trained physician or clinician, this data can be useful in determining a diagnosis. However, the data should not be used as a sole means for determining a patient's diagnosis.

WARNING To avoid serious injury or death, take these precautions during patient defibrillation:

- Avoid contact with the electrocardiograph, patient cable, and patient.
- Verify that the patient leads are properly connected. See "Connecting the Patient Cable" on page 20.
- Place defibrillator paddles properly in relation to electrodes.
- After defibrillation, pull each patient lead out of the patient cable and inspect the tips for charring (black carbon marks). If there is any charring, the patient cable and individual leads must be replaced. If there is no charring, fully reinsert the leads into the patient cable. (Charring can occur only if a lead is not fully inserted into the patient cable before defibrillation.)

WARNING To prevent the spread of infection, take these precautions:

- Dispose of single-use components (for example, electrodes) after using them once.
- Regularly clean and disinfect all components that come in contact with patients. See "Cleaning the Equipment" on page 58.
- Avoid ECG testing for patients with open, infectious sores.

WARNING Avoid positioning any leads or cables so that they could easily trip someone or become wrapped around a patient's neck.

WARNING Satisfactory maintenance procedures must be implemented, or equipment failure and health hazards may result.

WARNING Only qualified service personnel should attempt to repair the electrocardiograph. In case of a malfunction, call Technical Support and precisely describe the problem. For phone numbers, see page ii.

General Cautions

The following caution statements apply to electrocardiograph use in general. Caution statements that apply specifically to particular procedures, such as connecting the patient cable or performing an ECG test, appear in the corresponding sections of the manual.

Caution statements indicate conditions or practices that could damage the equipment or other property.

Caution When removing the electrocardiograph from storage, allow it to thermally stabilize to surrounding environmental conditions before using it.

Caution To prevent possible damage to the keypad, do not use sharp or hard objects to press keys. Only use fingertips.

Caution Do not expose the patient cable to strong ultra-violet radiation.

Caution Do not pull or stretch the patient cable. Doing so could result in mechanical or electrical failures. Form the patient cable into a loose loop before storing.

Caution Avoid positioning the patient cable where it might get pinched or stepped on. If the cable's impedance is altered, measurements might no longer be accurate, and repair might be necessary.

Caution Using the equipotential terminal for anything but grounding purposes may contribute to damage of the device.

Caution Use only parts and accessories supplied with the device and available through Welch Allyn. The use of accessories other than those specified may result in degraded performance of this device.

Caution Portable and mobile RF communications equipment can affect the performance of the electrocardiograph.

Caution The electrocardiograph meets the Class A requirements of IEC 60601-1-2:2000 regarding incidental emission of radio frequency interference. As such it is suitable for use in commercial grade electrical environments. If the electrocardiograph is used in residential grade electrical environments and you experience incidental interference with other equipment that uses radio frequency signals to operate, minimize the interference as described under "EMC Guidance and Manufacturer's Declarations" on page 75.

Caution Other medical equipment—including but not limited to defibrillators, ultrasound machines, pacemakers, and other stimulators—may be used simultaneously with the electrocardiograph. However, such devices may disturb the electrocardiograph signal.

Caution The power cord must be disconnected from AC power before cleaning, maintaining, or servicing.

Getting Help

You can get help with the electrocardiograph in a variety of ways beyond this manual.

- Press the Help key  from the **Ready** screen or **Lead Status** screen for a list of topics available to print.
- Review the other information that came with the electrocardiograph. For list, see "Product information" on page 6.
- Contact Welch Allyn. For phone numbers, see page ii.

2 Setting Up the Electrocardiograph

Inspecting the Electrocardiograph

1. Look for obvious signs of shipping damage. If you find any damage, contact Technical Support. For phone numbers, see page ii.
2. Verify that you have received all appropriate options and accessories. See "Options" on page 5 and "Accessories" on page 6.

Connecting the Patient Cable

WARNING Conductive parts of the patient cable, electrodes and associated connections of defibrillation-proof Type CF applied parts, including the neutral conductor of the patient cable and electrode, should not come into contact with other conductive parts, including earth ground.

WARNING To avoid injury to the patient or damage to the device, never plug patient leads into any other device or wall outlet.

1. Insert all leads into their proper positions, as labeled on the connectors.

   Insert connectors fully so that no part of the metal ring remains exposed. For example, see Figure 12. (To see the whole patient cable with all leads inserted, see Figure 11 on page 12.)

   WARNING Failure to insert all connectors fully may result in a loss of energy being delivered to the patient during defibrillation and damage to the patient cable itself. For other warnings related to defibrillation, see page 16.

2. Plug the patient cable into the port on the front of the electrocardiograph. See Figure 13.

Figure 12. Inserting the Leads

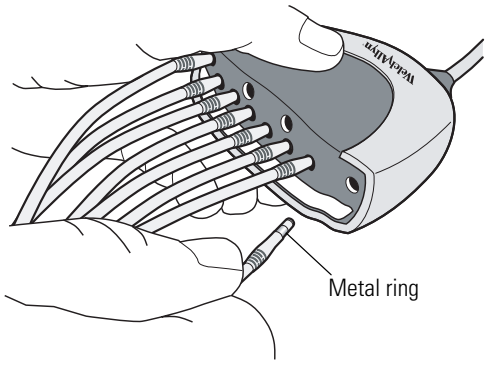
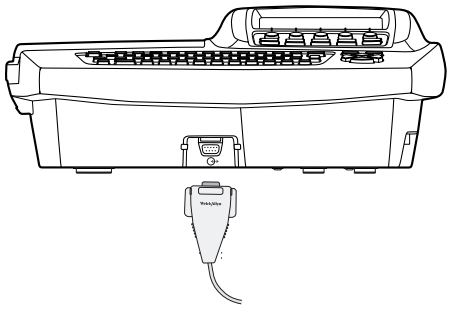


Figure 13. Plugging in the Connector



Loading the Thermal Chart Paper

1. Squeeze the latch. Pull the paper door to the left. See Figure 14.

   If any paper remains in the tray, remove it.

2. Remove the outer packaging, including the cardboard bottom, from a new pack of paper. Pull the top sheet back so that the paper's grid side faces up and the Welch Allyn name is on the bottom of the paper.

3. Slide the paper into the tray. See Figure 15.

   If humidity is high, remove up to 10 sheets so that the paper fits properly.

4. Lay the top sheet over the paper door. Push the door to the right until it clicks. See Figure 16.

Figure 14. Opening the Paper Door

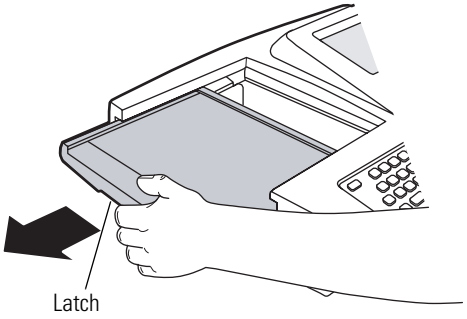


Figure 15. Loading the Paper

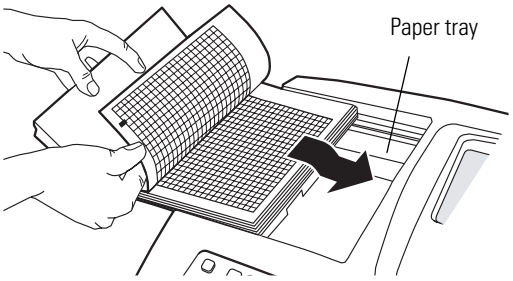
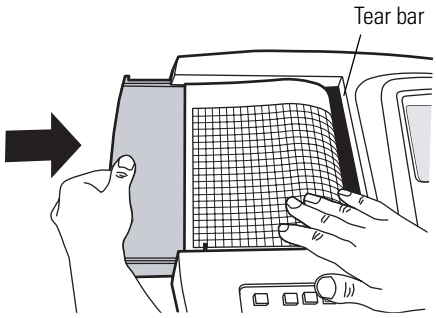


Figure 16. Closing the Paper Door



Tips for handling thermal paper:

- Store in a cool, dry, dark place.
- Avoid exposure to bright light or UV sources.
- Avoid exposure to solvents, adhesives, or cleaning fluids.
- Do not store with vinyls, plastics, or shrink wraps.

Powering the Electrocardiograph

The electrocardiograph can run on AC or battery power.

WARNING To ensure that electrical safety is maintained when using AC power, the device must be plugged into a hospital-grade outlet.

WARNING Where the integrity of external protective earth conductor arrangement is in doubt, use battery power.

Caution Medical electrical equipment needs special precautions regarding EMC and must be installed and used according to the information provided in "EMC Guidance and Manufacturer's Declarations" on page 75.

To Connect to AC Power

Plug one end of the power cord into the electrocardiograph's AC power inlet. Plug the other end into an AC outlet. The green LED on the keyboard lights up, indicating that power is connected. See Figure 17.

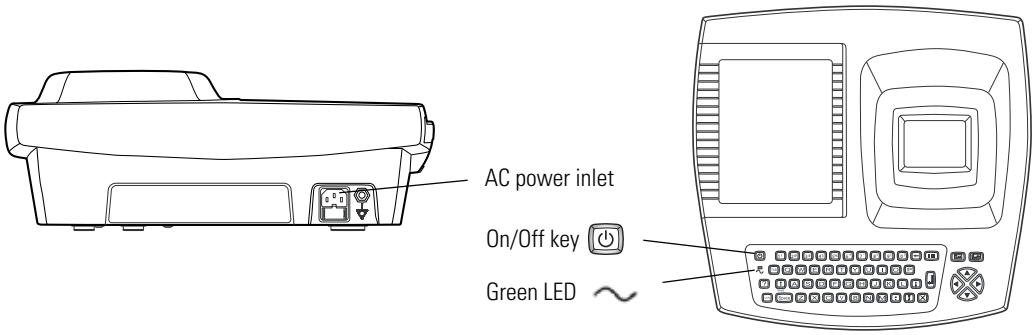
To Keep the Battery Charged

Leave the electrocardiograph connected to AC power whenever possible. Battery charge status is indicated on the screen by an icon: . Whenever the battery is charging and is not yet fully charged, this icon appears: . For maximum battery performance, as often as possible leave the electrocardiograph plugged in until you see the "fully charged" icon: .

When the charge gets low, the icon flashes. When the charge gets too low to operate, a warning message appears and the electrocardiograph beeps every 15 seconds for 1 minute, then it turns off.

For more, see "Recharging a Fully Discharged Battery" on page 60.

Figure 17. AC Power Inlet and Green LED



To Turn the Electrocardiograph On

Press  .

To Turn the Electrocardiograph Off

Press  and hold.

Note If Power-Save is enabled, the electrocardiograph turns off automatically after several idle minutes. To learn how to enable or disable Power-Save, see "Reviewing the Device Configuration Settings" on page 27.

Verifying Proper Operation

Once your electrocardiograph is set up, verify proper operation by using an ECG simulator to acquire and print a standard 12-lead ECG of known amplitude. See Step 2 on page 59.

Note As part of your initial set-up, you may want to adjust the display contrast. To learn how, see "Reviewing the Device Configuration Settings" on page 27.

You may also want to change other software settings, as described in the following chapters:

- "Reviewing the System Settings" on page 25
- "Reviewing the ECG Settings" on page 31

Connecting an External USB Printer (Optional)

If desired, you can connect an external printer. It must be a USB inkjet or laser printer that supports PCL (printer control language), such as the following:

Vendor	Model	PCL Version
HP	Deskjet 995c	PCL 3
HP	Deskjet 5650	PCL 3 enhanced
HP	Laser 1022	PCL 5E
Dell	Laser 1710	PCL 5E & PCL 6
Lexmark	Laser E240	PCL 6

No special software is required.

The external printer prints the following (always in black and white):

- Auto ECG reports
- Device settings
- Help pages

Rhythm ECGs always print to the internal printer.

See the warning regarding signal I/O connectors on *page 15*.

To Connect a Printer

Connect one end of a USB cable to the printer's USB connector, and connect the other end to the electrocardiograph's USB connector: 10101. For connector location, see Figure 5 on page 8.

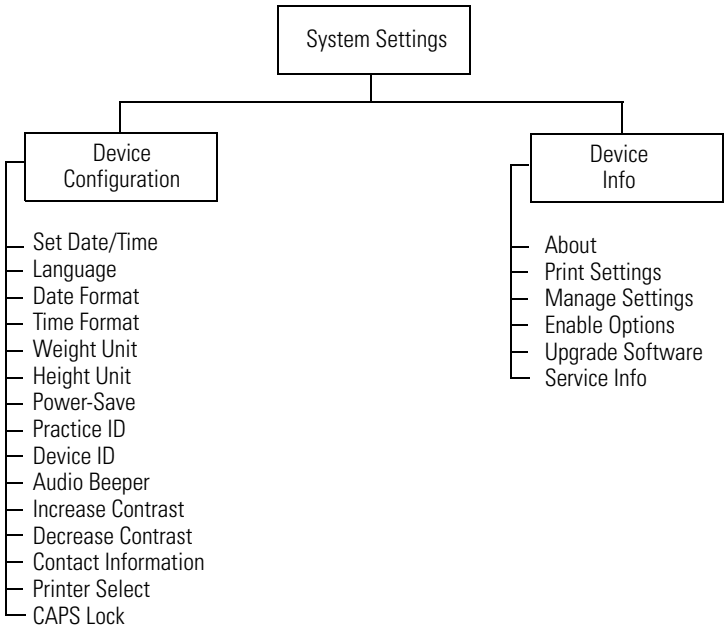
To learn how to enable the external printer in the settings, see "Reviewing the Device Configuration Settings" on page 27.

3 Reviewing the System Settings

This chapter documents the system settings. For information on the following related tasks, see the procedures identified here:

- **Reviewing ECG settings**
  See "Reviewing the ECG Settings" on page 31.
- **Printing all settings**
  See "Reviewing the Device Information" on page 29.

"System Settings" Menu Tree

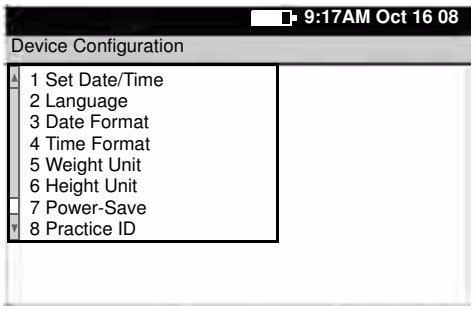


Reviewing the Device Configuration Settings

1. Press the Menu key .
2. Choose **System Settings** > **Device Configuration**.

   The following screen appears.

Figure 18. "Device Configuration" Screen



3. Change any desired settings.

Setting	Description
Set Date/Time	Current date and time.
Language	List of languages available. Changes take effect when the next screen appears.
Date Format	MM/DD/YY (month/day/year) DD/MM/YY (day/month/year)
Time Format	24-hour or AM/PM.
Weight Unit	Kilograms (kg) or pounds (lb).
Height Unit	Centimeters (cm), inches (in), or feet and inches (ft, in).
Power-Save	On or off. When on, the electrocardiograph turns itself off after several idle minutes.
Practice ID	Name of the practice, clinic, or hospital. This ID prints on all ECG reports.
Device ID	Electrocardiograph identification. Enter up to 20 characters. This ID prints on all ECG reports.
Audio Beeper	On or off. When on, beeps to indicate errors, such as incorrect input, improper external connections, or a printer error. Beeps may also indicate a low battery.
Increase Contrast	Each time you select this choice, the display contrast immediately increases until you reach maximum contrast.
Decrease Contrast	Each time you select this choice, the display contrast immediately decreases until you reach minimum contrast.
Contact Information	Your office. Enter up to 40 characters. This information will appear on the accessories Help page.

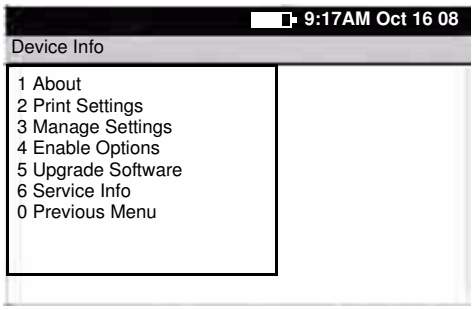
Setting (Continued)	Description (Continued)
Printer Select	Internal or External. When "External" is selected — and when an external printer is connected and turned on — reports will print to that printer. For details, see "Connecting an External USB Printer (Optional)" on page 24.
CAPS Lock	On or off. Works just like a standard CAPS Lock key.

Reviewing the Device Information

1. Press the Menu key .
2. Choose **System Settings** > **Device Info**.

   The following screen appears.

Figure 19. "Device Info" Screen



3. Select the desired item:

Item	Description
About	Displays the following information about the electrocardiograph: • serial number • modules configured • version numbers
Print Settings	Prints your ECG and system settings.
Manage Settings	See "Transferring a Configuration to Another Electrocardiograph" on page 30.
Enable Options	Contact Technical Support. For phone numbers, see page ii.
Upgrade Software	Contact Technical Support. For phone numbers, see page ii.
Service Info	Accessible to service support only.

Transferring a Configuration to Another Electrocardiograph

You can transfer your configuration from one CP 100 electrocardiograph to another.

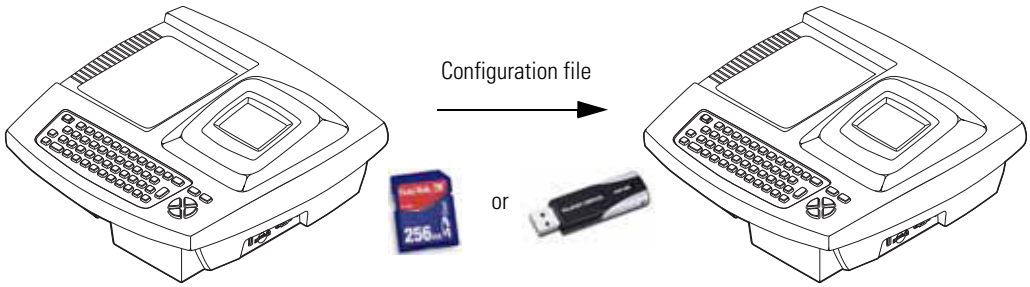
To Transfer a Configuration

1. Insert a storage device (SD memory card or removable USB device) into an electrocardiograph that is configured as desired.
2. Press the Menu key .
3. Choose **System Settings** > **Device Info** > **Manage Settings** > **Export Files** > **Export Configuration Files**.

   The files are copied to the storage device.
4. Remove the storage device, and insert it into another CP 100 electrocardiograph.
5. Choose **System Settings** > **Device Info** > **Manage Settings** > **Import Files** > **Import Configuration Files**.

   The files are copied to the electrocardiograph, and then it reboots.

Figure 20. Configuration File Transfer

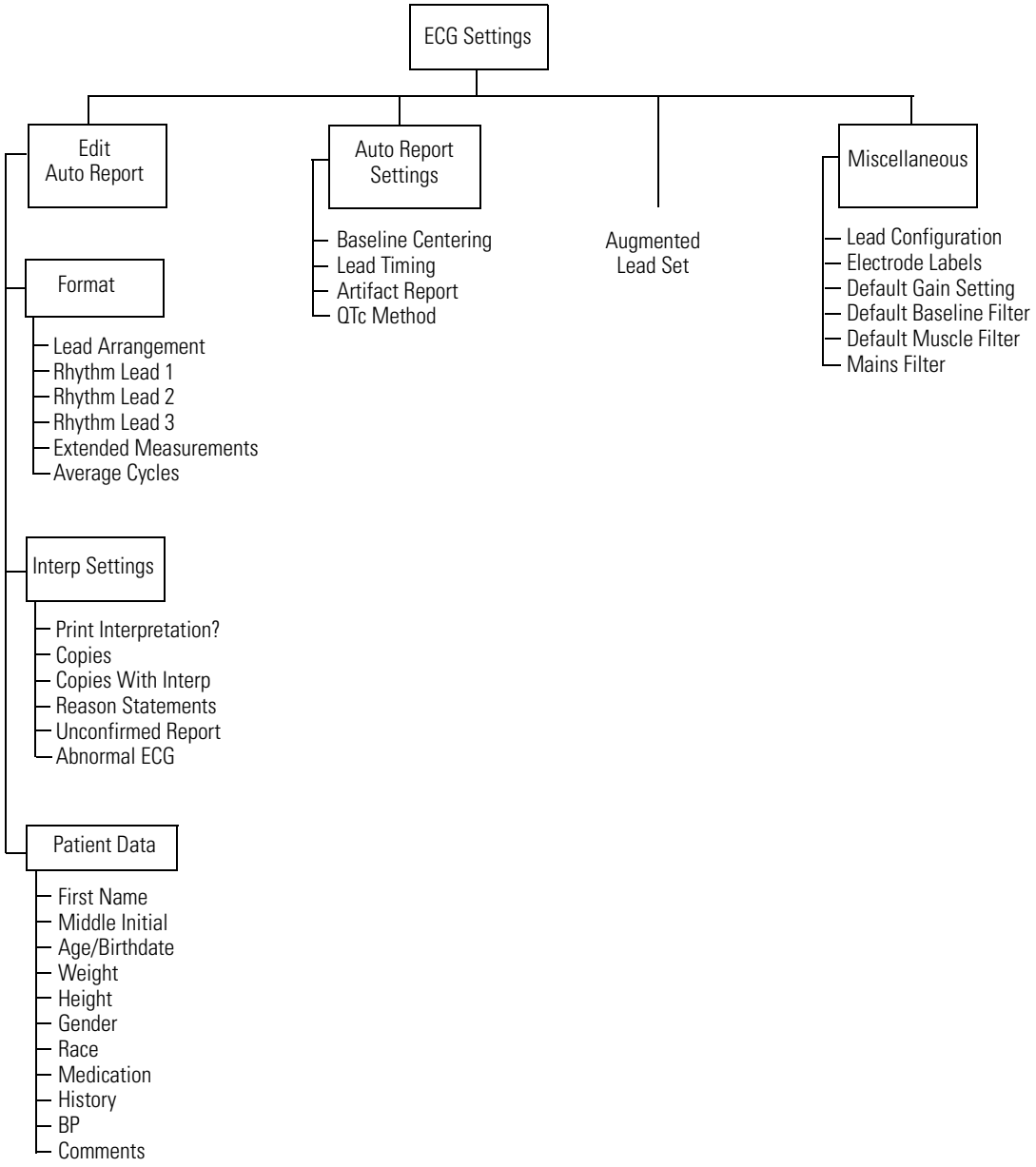


4 Reviewing the ECG Settings

This chapter documents the ECG settings. For information on the following related tasks, see the procedures identified here:

- **Reviewing system settings**
  See "Reviewing the System Settings" on page 25.
- **Printing all settings**
  See "Reviewing the Device Information" on page 29.

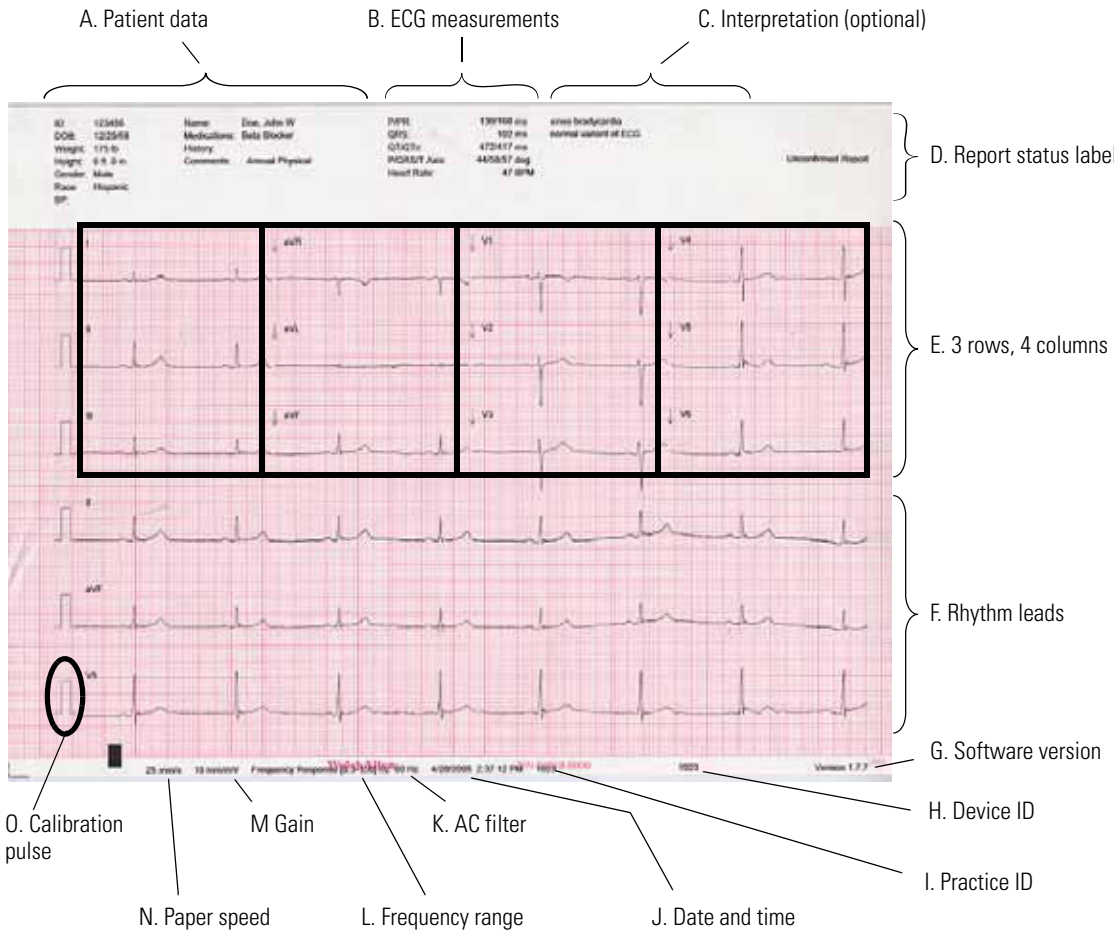
"ECG Settings" Menu Tree



About Auto ECG Reports

An Auto ECG is a report of ECG data in a user-defined format. For an example, see Figure 21. To learn how to set up or interpret a report, see the references on page 34.

Figure 21. Auto Report Example — 3x4 +3R Lead Arrangement



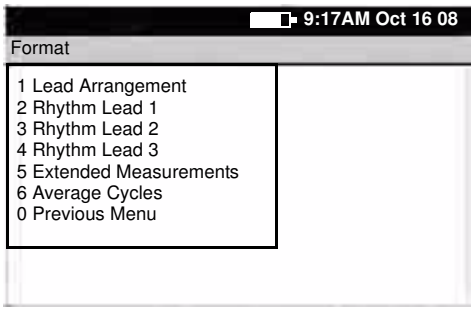
Item (in Figure 21 on page 33)	Description
A. Patient data	See "Reviewing the Patient Data Fields Available" on page 37.
B. ECG measurements	Standard.
C. Interpretation (optional)	See "Reviewing the Interpretation and Copy Settings for Auto Reports" on page 36.
D. Report status label	See "Reviewing the Interpretation and Copy Settings for Auto Reports" on page 36.
E. 3 rows, 4 columns	See "Reviewing the Format Settings for Auto Reports" on page 35.
F. Rhythm leads	See "Reviewing the Format Settings for Auto Reports" on page 35.
G. Software version	See also "Reviewing the Device Information" on page 29.
H. Device ID	See "Device ID" on page 27.
I. Practice ID	See "Practice ID" on page 27.
J. Date and time	See "Set Date/Time" on page 27.
K. AC filter	See "Mains Filter" on page 40.
L. Frequency range	Lower limit: baseline filter on = 0.5, off = 0.3 Upper limit: muscle filter on = 35, off = 150 See "Adjust Baseline Filter" on page 55 and "Adjust Muscle Filter" on page 55.
M Gain	See "Adjust Gain" on page 55.
N. Paper speed	See "Adjust Speed" on page 55.
O. Calibration pulse	Amplitude reference — represents the current height of a one-millivolt signal. Is adjusted for the selected gain: 5 mm/mV = 0.5 x 10 mm/mV = 1 x 20 mm/mV = 2 x

Reviewing the Format Settings for Auto Reports

1. Press the Menu key .
2. Choose **ECG Settings** > **Edit Auto Report** > **Format**.

   The following screen appears.

Figure 22. Auto Report "Format" Screen



3. Change any desired settings.

   For a report example, see Figure 21 on page 33.

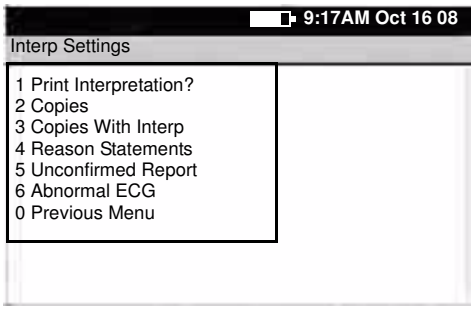
Setting	Description
Lead Arrangement	Arrangement of the leads on the report. • 3x4 — 3 rows x 4 columns • 3x4 +1R — 3 rows x 4 columns + 1 rhythm lead • 3x4 +3R — 3 rows x 4 columns + 3 rhythm leads • 6x2 — 6 rows x 2 columns • 12x1 — 12 rows x 1 column • 6x2 50 mm/s — 6 rows x 2 columns, 50 mm/s • 6x2 Ext. — 6 rows x 2 columns, extended printouts (two pages, 20 seconds of ECG data) • 2x6 +1R — 2 rows x 6 columns + 1 rhythm lead • 6x2 +1R — 6 rows x 2 columns + 1 rhythm lead • No Print — No report prints
Rhythm Lead 1	Rhythm lead to print at the bottom of all "+R" reports.
Rhythm Lead 2	Second rhythm lead to print at the bottom of 3x4 +3R reports.
Rhythm Lead 3	Third rhythm lead to print at the bottom of 3x4 +3R reports.
Extended Measurements	On or off. When on, an additional page prints with the report. Extended measurements include the values for several common parameters, such as Q, R, and S amplitude and ST values. The amplitudes are expressed in microvolts. The durations are expressed in milliseconds. The measurements cannot be edited.
Average Cycles	If desired, an additional page prints with the report. Average cycles show the dominant waveforms for all 12 leads. • 3x4 50 mm/s + 3R — 3 rows x 4 columns + 3 rhythm leads, 50 mm/s • 6x2 50 mm/s + 6R — 6 rows x 2 columns + 6 rhythm leads, 50 mm/s • No Print — Average cycles page does not print.

Reviewing the Interpretation and Copy Settings for Auto Reports

1. Press the Menu key .
2. Choose **ECG Settings** > **Edit Auto Report** > **Interp Settings**.

   The following screen appears.

Figure 23. "Interpretation Settings" Screen



3. Change any desired settings.

   For a report example, see Figure 21 on page 33.

Setting	Description
Print Interpretation?	On or off. Determines whether interpretation is printed and saved with reports.
Copies	Number of copies to print automatically in addition to the original report: 0, 1, 2, 3, 4, or 5.
Copies With Interp	On or off. Determines whether interpretation is printed on the automatic copies.
Reason Statements	On or off. Determines whether reasons (criteria) are printed with the interpretation statements.
Unconfirmed Report	On or off. Determines whether the label "Unconfirmed Report" is printed on reports.
Abnormal ECG	On or off. Determines whether the label "Abnormal ECG" is printed on reports. Available only for systems using automatic interpretation.

Reviewing the Patient Data Fields Available

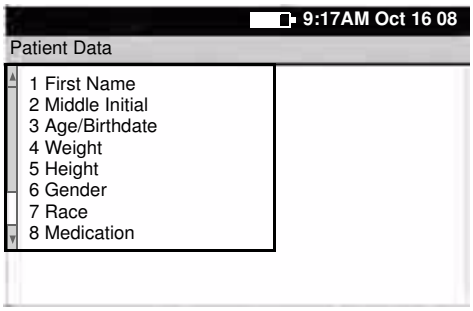
You can determine which fields appear during patient data entry.

To Choose the Fields

1. Press the Menu key .
2. Choose **ECG Settings** > **Edit Auto Report** > **Patient Data**.

   The following screen appears.

Figure 24. "Patient Data" Screen



The **Patient ID** and **Last Name** fields always appear on the **Enter New Patient** screen, as shown in Figure 32 on page 49. Since these two fields cannot be disabled, they do not appear on this user-selectable list.

3. Change any desired settings.

   Disabled items (set to *off* or *no*) neither display nor print.

Field	Description
First Name	Yes or no. If yes, this field is enabled.
Middle Initial	Yes or no. If yes, this field is enabled.
Age/Birthdate	Birthdate, age, or off. Determines whether and how this data is labeled and entered. If you'll be testing patients from 1 day through 17 years old, select Birthdate for most accurate results. If "age" is selected, age will be entered in years and months.
Weight	Yes or no. If yes, this field is enabled for entering patients' weight. For instructions on changing the weight units (kg or lb), see "Reviewing the Device Configuration Settings" on page 27.
Height	Yes or no. If yes, this field is enabled for entering patients' height. For instructions on changing the height units (cm, in., or ft and in.), see "Reviewing the Device Configuration Settings" on page 27.
Gender	Yes or no. If yes, this field is enabled. Data-entry choices: Male, Female, or Unknown.
Race	Yes or no. If yes, this field is enabled. Data-entry choices: Blank, Caucasian, Black, Hispanic, Asian, Unknown.
Medication	Yes or no. If yes, this field is enabled. During data entry, choose one item from the list of patient medications.
History	Yes or no. If yes, this field is enabled. During data entry, choose one item from the list of patient clinical conditions.

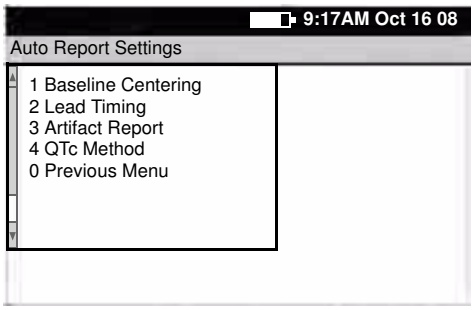
Field (Continued)	Description (Continued)
BP	Yes or no. If yes, this field is enabled for entering blood pressure in standard ### / ### format.
Comments	Yes or no. If yes, this field is enabled for entering comments.

Reviewing the Auto Report Settings

1. Press the Menu key .
2. Choose **ECG Settings** > **Auto Report Settings**.

   The following screen appears.

Figure 25. "Auto Report Settings" Screen for ECG Settings



3. Change any desired settings.

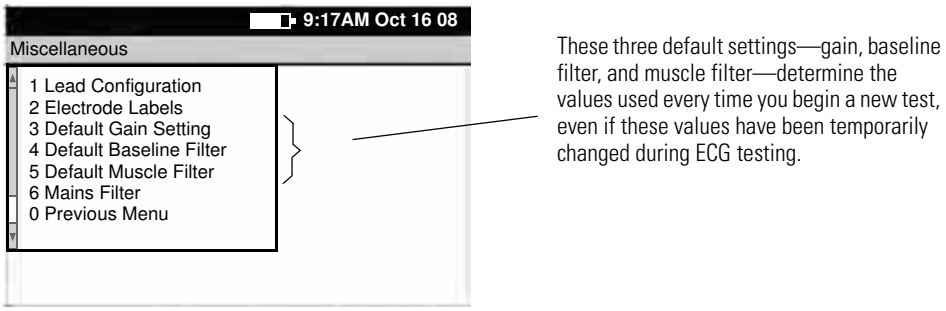
Setting	Description
Baseline Centering	On or off. When on, aligns the isolectric line of all leads.
Lead Timing	Simultaneous or sequential. "Simultaneous" prints ECG data that was captured simultaneously for all lead groups. "Sequential" prints ECG data that was captured at sequential intervals for each lead group in turn.
Artifact Report	On or off. When on, the electrocardiograph automatically prints an artifact report with the Auto ECG report whenever artifact is detected and you override the "Waiting for 10 seconds of quality data" message. This report, a 12x1 format with all filters disabled, shows the leads with artifact so that you can remedy the problem. (The normal Auto ECG report, with filters enabled, might mask some of the artifact issues.)
QTc Method	Bazett or Hodges. Computation method of correcting the waveform's QT interval based on the heart rate. The corrected number, expressed in milliseconds, is called the QTc interval. This setting affects only the QTc interval displayed in the ECG measurements portion of the ECG report.

Reviewing the Miscellaneous ECG Settings

1. Press the Menu key .
2. Choose **ECG Settings** > **Miscellaneous**.

   The following screen appears.

Figure 26. "Miscellaneous" Screen for ECG Settings



3. Change any desired settings.

Setting	Description
Lead Configuration	Standard (I II III, aVR aVL aVF, V1 V2 V3, V4 V5 V6) or Cabrera (aVL I –aVR, II aVF III, V1 V2 V3, V4 V5 V6).
Electrode Labels	AHA or IEC.
Default Gain Setting	5 mm/mV, 10 mm/mV, 20 mm/mV, or Auto. (AUTO is available for Auto ECGs only, not rhythm ECGs. AUTO is usually the best setting, but some waveforms may be easier to read on other settings.) For details, see "Adjust Gain" on page 55.
Default Baseline Filter	On or off. For details, see "Adjust Baseline Filter" on page 55.
Default Muscle Filter	On or off. For details, see "Adjust Muscle Filter" on page 55.
Mains Filter	Off, 50 Hz, 60 Hz. Use of this filter is recommended. For suggestions on eliminating AC interference, see page 69.

Turning the Augmented Pediatric Lead Set On and Off

For a description of the augmented pediatric lead set, see page 4.

1. Press the Menu key  .
2. Choose **ECG Settings** > **Augmented Lead Set** > **On** or **Off**.

   When this option is turned on, the system will prompt you to select the lead set — standard or augmented — each time you perform a test on a new patient.

5 Performing ECG Tests

Connecting the Leads to the Patient

1. Help the patient get comfortable. Patient preparation is important for a successful ECG.
   a. Describe the procedure. If desired, press the Help key  and print the page entitled "What Is An ECG?" for the patient to read.
   b. Help the patient get warm and relaxed. Excessive patient movement could interfere with the operation of the electrocardiograph.
   c. Put the patient in a reclining position with the head slightly higher than the heart and legs.

   WARNING ECG electrodes could cause skin irritation. Examine the skin for signs of irritation or inflammation.

2. Prepare electrode locations. See Figure 27 on page 45 or *Figure 28* on page 46.
   a. Shave if necessary.
   b. Clean with alcohol or acetone.
   c. Allow to dry.
3. Attach the electrodes and lead wires securely.
   - For reusable electrodes:

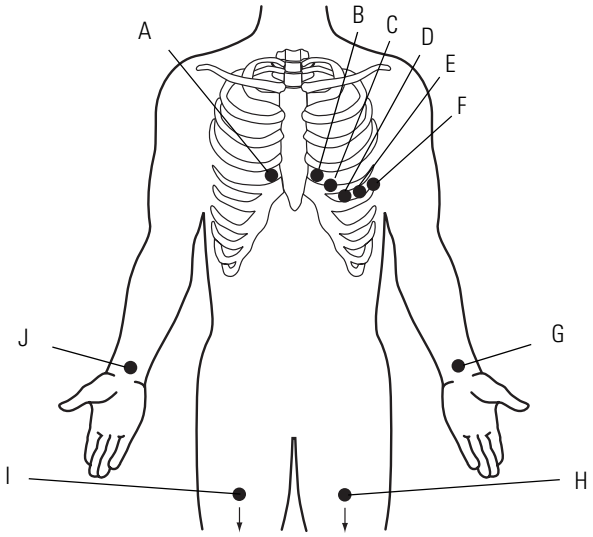
     Straps must neither slide nor be so tight as to cause discomfort.

     The electrode paste, gel, or creme must cover an area the size of the electrode but no larger, especially on the chest.
   - For disposable tab electrodes:

     Place the electrode tab between the "jaws" of the electrode adapter, keeping the tab flat.

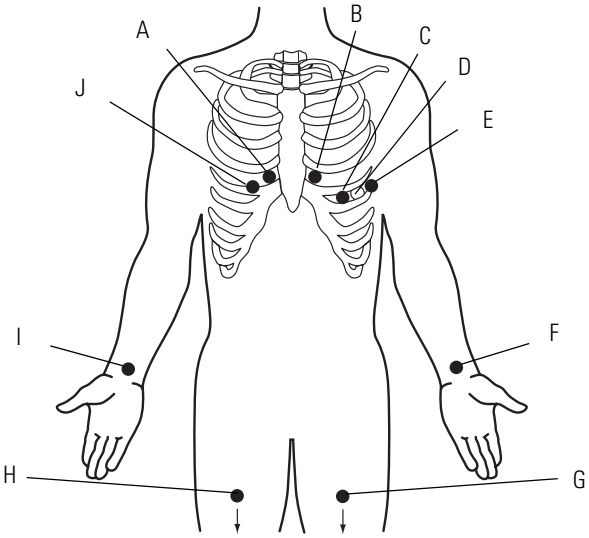
     Gently tug on the adapter to ensure that it is properly placed on the electrode. (Each time you remove and reattach an electrode, the conductive gel becomes weaker and less effective.)

Figure 27. Electrode Placement Locations — Adult and Standard Pediatric



	Electrodes		
	AHA	**IEC**	**Locations**
A	V1 red	C1 red	Fourth intercostal space at right sternal border.
B	V2 yellow	C2 yellow	Fourth intercostal space at left sternal border.
C	V3 green	C3 green	Midway between V2 and V4.
D	V4 blue	C4 brown	Fifth intercostal space at left of midclavicular line.
E	V5 orange	C5 black	Anterior axillary line at same horizontal level as V4.
F	V6 purple	C6 purple	Mid-axillary line on same horizontal level as V4 and V5.
G	LA black	L yellow	Just above left wrist on inside of arm.
H	LL red	F green	Just above left ankle.
I	RL green	N black	Just above right ankle.
J	RA white	R red	Just above right wrist on inside of arm.

Figure 28. Electrode Placement Locations — Augmented Pediatric

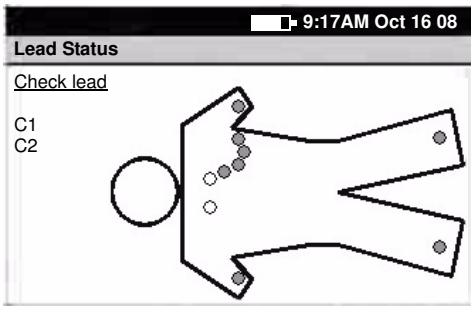


To use the augmented pediatric lead set, you must enable it in the settings. See "Turning the Augmented Pediatric Lead Set On and Off" on page 41.

	Electrodes		
	AHA	**IEC**	**Locations**
A	V1 red	C1 red	Fourth intercostal space at right sternal border.
B	V2 yellow	C2 yellow	Fourth intercostal space at left sternal border.
C	V4 blue	C4 brown	Fifth intercostal space at left of midclavicular line.
D	V7 orange	C7 black	Posterior axillary line at the same horizontal level as V4.
E	V6 purple	C6 purple	Mid-axillary line on same horizontal level as V4.
F	LA black	L yellow	Just above left wrist on inside of arm.
G	LL red	F green	Just above left ankle.
H	RL green	N black	Just above right ankle.
I	RA white	R red	Just above right wrist on inside of arm.
J	V3R green	C3R green	Mirror position to standard V3 placement with respect to the mid-sternal line.

4. If the electrocardiograph's display is blank, press  .
5. If prompted to select a lead set type, select **Standard** or **Augmented**.
   For a description of the augmented pediatric lead set, see page 4.
6. If the **Lead Status** screen appears, as shown here, reattach any leads that are flashing.

Figure 29. "Lead Status" Screen

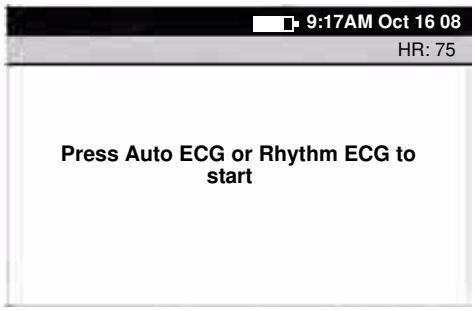


The term "Artifact" might also appear on this screen. To eliminate artifact, you might need to re-prep the patient, use fresh electrodes, or minimize patient motion during the recording.

The most common ECG problems are poor electrode contact and loose leads.

When all leads have been connected for several seconds, the following screen appears.

Figure 30. "Ready" Screen



7. Go to the procedure for the type of ECG test you want to perform.
   - "Recording an Auto ECG" on page 48
   - "Recording a Rhythm ECG" on page 54

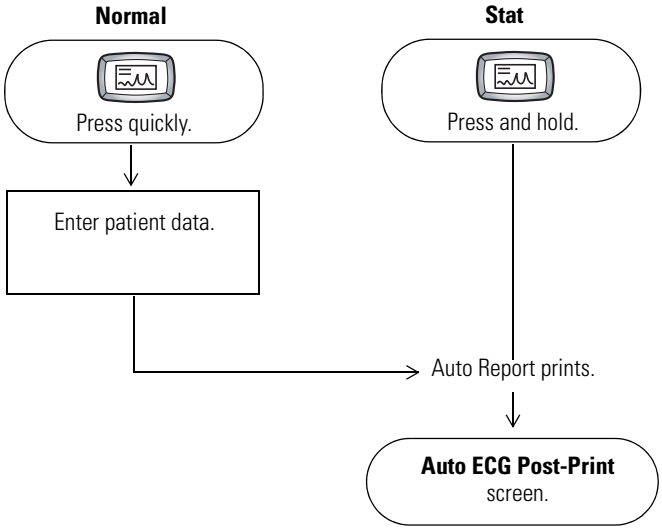
Recording an Auto ECG

An Auto ECG is a report typically showing a 10-second acquisition of 12 leads of ECG information combined with patient data, interpretation, and measurements matrix. To learn how to set up the Auto ECG report format, see "About Auto ECG Reports" on page 33.

As shown in the following diagram, there are the two types of Auto ECG: normal and stat. For details, see these procedures:

- "Recording a Normal Auto ECG" on page 49
- "Recording a Stat Auto ECG" on page 53

Figure 31. Auto ECG Testing, Process Diagram



Recording a Normal Auto ECG

For a normal Auto ECG, you enter patient data and do other optional tasks before printing, as shown in Figure 31 on page 48.

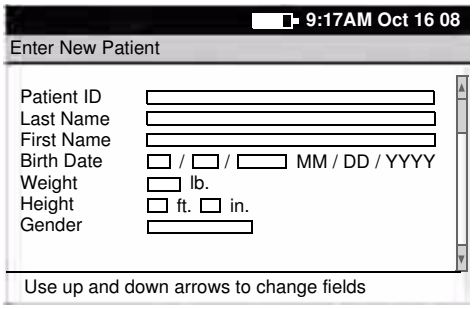
To Record a Normal Auto ECG

1. Press the **Auto ECG** key quickly.

   Do not hold it down, or a stat ECG would begin.

   The following screen appears.

Figure 32. "Enter New Patient" Screen

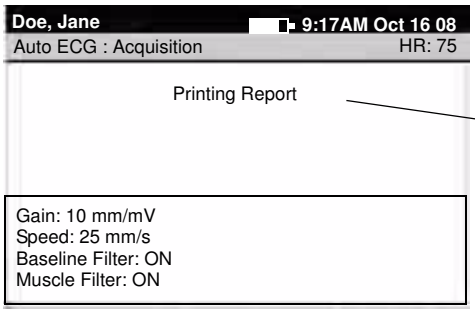


For details about these data fields—including how to choose which fields display and print—see "Reviewing the Patient Data Fields Available" on page 37.

2. Enter the patient data.
3. When finished, select **Done** (at the end of the list).

   The **Auto ECG Acquisition** screen appears. See Figure 33 on page 50.

Figure 33. "Auto ECG Acquisition" Screen



The electrocardiograph displays messages here when it is doing the following:

- Collecting data
- Analyzing data
- Printing the report

4. If prompted, choose whether to wait for the electrocardiograph to acquire 10 seconds of filtered, processed data before printing.

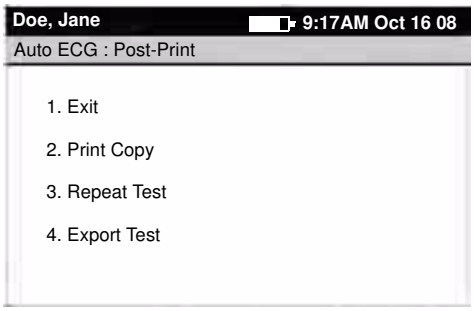
   If you override the wait time and print the available data immediately, be aware that the printed data will be insufficient in quality or quantity or both.

   The report prints.

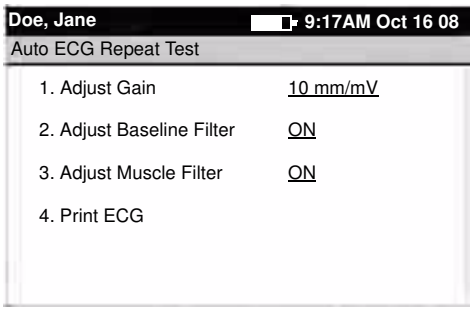
   Note If a red stripe appears along the edge of your report, replace the paper. See "Loading the Thermal Chart Paper" on page 21.

After printing, the **Auto ECG Post-Print** screen appears. Figure 34 on page 51.

Figure 34. "Auto ECG Post-Print" Screen



5. Select the desired item.

Item	Effect
Exit	The **Ready** screen appears if all leads are connected to the patient.
Print Copy	A copy of the test prints. To learn how to print multiple copies of all tests automatically, see "Reviewing the Interpretation and Copy Settings for Auto Reports" on page 36.
Repeat Test	The following screen appears. **Figure 35. "Auto ECG Repeat Test" Screen**  1. (Optional) Adjust the waveforms. See "Adjusting the ECG Waveforms" on page 55. 2. Choose **Print ECG**. A new report prints.
Export Test	Sends the test to the memory card. An SD memory card or removable USB storage device must be in place.

Caution The requirements of AAMI EC11, Section 3.2.7.2, Frequency and Impulse Response, for an impulse triangle waveform may be impacted by up to 5 milliseconds of small amplitude dampened ringing immediately after the impulse when the muscle filter (35 Hz) is turned on or a small amplitude offset when the baseline filter (0.5 Hz) is turned on. These requirements are unaffected by any other combination of filters turned on or off. Measurements performed by the optional interpretation algorithm are unaffected by any filter selections.

Recording a Stat Auto ECG

A stat Auto ECG is an immediate printout.

Stat mode bypasses patient data entry, as shown in Figure 31 on page 48. A temporary ID number is assigned to the patient to identify stat tests.

To Record a Stat Auto ECG

1. Press and hold the **Auto ECG** key  .

   The electrocardiograph begins acquiring ECG data. After it has acquired 10 seconds of quality data, it prints a report.

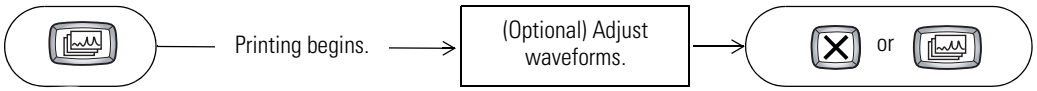
2. Go to Step 4 on page 50.

Recording a Rhythm ECG

A Rhythm ECG is a continuous, real-time printout of three leads at a time.

Rhythm ECGs are printouts only. They cannot be sent to an SD memory card or removable USB storage device.

Figure 36. Rhythm ECG Testing, Process Diagram

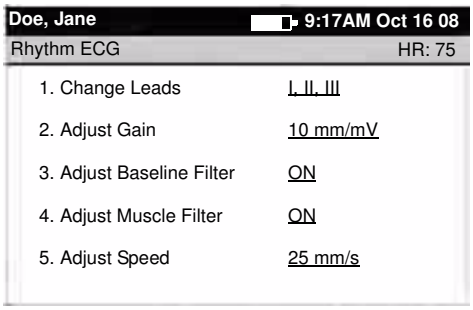


To Record a Rhythm ECG

1. Press the **Rhythm ECG** key .

   Printing begins, and the following screen appears.

Figure 37. "Rhythm ECG" Screen



2. (Optional) Adjust the waveforms.

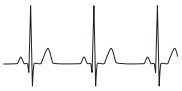
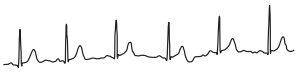
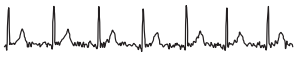
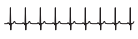
   See "Adjusting the ECG Waveforms" on page 55.

3. Press or to stop printing.

   The **Ready** screen appears if all leads are connected to the patient.

Adjusting the ECG Waveforms

To adjust the waveforms after printing an Auto ECG or while printing a rhythm ECG, press an item's number key as needed until the desired choice appears.

Item	Effect
Change Leads (available for Rhythm ECG only)	Cycles through the lead groups three at a time.
Adjust Gain	Cycles through the gain settings in mm/mV (5, 10, 20, AUTO), changing the waveform size. (AUTO is available for Auto ECGs only, not rhythm ECGs. AUTO is usually the best setting, but some waveforms may be easier to read on other settings.) To learn how to change the gain's default setting, see "Reviewing the Miscellaneous ECG Settings" on page 40.  5 mm/mV  10 mm/mV  20 mm/mV
Adjust Baseline Filter	Toggles between the two baseline filter settings (on or off). This filter reduces "wandering baseline," an upward and downward fluctuation of the waveforms. It is preferable, if possible, to eliminate or reduce wandering baseline by addressing the causes, as explained on page 68. To learn how to change the filter's default setting, see "Reviewing the Miscellaneous ECG Settings" on page 40. Caution: You cannot perform ST segment analysis on waveforms that were recorded with the muscle filter turned on. For details, see the caution on page 52.  Wandering baseline
Adjust Muscle Filter	Toggles between the two muscle filter settings (on or off). This filter reduces muscle tremor interference: random, irregular voltage superimposed on the waveforms. It is preferable, if possible, to eliminate or reduce muscle tremor by addressing the causes, as explained on page 68. To learn how to change the filter's default setting, see "Reviewing the Miscellaneous ECG Settings" on page 40. Caution: You cannot perform ST segment analysis on waveforms that were recorded with the muscle filter turned on. For details, see the caution on page 52.  Muscle tremor interference
Adjust Speed (available for Rhythm ECG only)	Cycles through the paper speed settings in mm/sec (10, 25, 50).  10 mm/sec  25 mm/sec  50 mm/sec

6 Maintaining the Electrocardiograph

Inspecting the Equipment

WARNING To ensure patient safety and proper operation, perform the following inspections daily.

- Verify that patient leads are fully inserted. For details, see "Connecting the Patient Cable" on page 20.
- Check for cracked or broken patient cable, patient leads, power cord, communications cables, display, and enclosure.
- Check for bent or missing pins on all cables.
- Check all cable and cord connections; reseat if any connectors are loose.

Cleaning the Equipment

WARNING To prevent the spread of infection, the electrocardiograph and patient cable must be kept clean, especially the components that come in contact with patients.

Caution Do not let soap or water come into contact with the electrocardiograph's internal printer, connectors, or jacks.

Do not attempt to clean the electrocardiograph or the patient cable by submersing them in liquid, autoclaving, or steam cleaning. Do not pour alcohol directly on the equipment or soak any components in alcohol. If alcohol or liquids spill into the electrocardiograph while cleaning, arrange to have it checked before using it again. For Welch Allyn phone numbers, see page ii.

Monthly, or more often if needed, follow these cleaning instructions:

1. Disconnect the power plug from the AC outlet.
2. Wipe the exterior of the patient cable and electrocardiograph and with a damp cloth using mild detergent diluted in water.
3. Use 70% isopropyl alcohol to disinfect patient cable, lead wires, and equipment.
4. Dry all components with a clean, soft cloth or paper towel.
5. Wait at least 10 minutes to allow all traces of alcohol to evaporate before turning the electrocardiograph back on.

Testing the Equipment

WARNING Only qualified service personnel should perform leakage current tests.

Whenever the electrocardiograph is serviced or problems are suspected, Welch Allyn recommends the following test procedures:

1. Verify continued electrical safety of the device, using IEC 60601-1 or ANSI/AAMI ES1 methods and limits. Test for the following:

   - Patient leakage current
   - Chassis leakage current
   - Earth leakage current
   - Dielectric strength (AC and patient circuits)

2. Verify that the electrocardiograph is working properly, using an ECG simulator to acquire and print a standard 12-lead ECG of known amplitude.

   - Printing should be dark and even across the page.
   - There should be no evidence of print-head dot failure (no printing breaks forming horizontal streaks).
   - Paper should move smoothly and consistently during printing.
   - Waveforms should appear normal, with proper amplitude, and without distortion or excessive noise.
   - Paper should stop with perforations near the tear bar, indicating proper cue-sensor operation. For tear-bar location, see Figure 16 on page 21.

Recharging a Fully Discharged Battery

If the electrocardiograph does not turn on when unplugged, the battery may be fully discharged.

Note Regardless of the battery condition, you can use the electrocardiograph whenever it is plugged in.

To Recharge the Battery

1. Plug the electrocardiograph into AC power.
2. Verify that the green LED on the keyboard lights up. (See Figure 17 on page 22.)

   If the LED does not light up, go to "Replacing the AC Fuses" on page 64.
3. Keep the electrocardiograph plugged in for 12 hours.

The first time you turn the electrocardiograph on after a full battery discharge, you are prompted to reenter the date and time.

If the electrocardiograph still does not turn on when it is unplugged from AC power, you may need to replace the battery or battery fuse. See "Replacing the Battery" on page 61 or "Replacing the Battery (DC) Fuse" on page 63.

Replacing the Battery

If you have recharged the battery and the electrocardiograph still does not turn on when unplugged, or if the battery loses its charge quickly, replace the battery as follows. (For part number, see "Accessories" on page 6.)

1. Unplug the electrocardiograph from AC power if connected.
2. Turn the electrocardiograph upside-down.
3. Unscrew and remove the battery door. See Figure 38.
4. Lift out the battery. See Figure 39.

Figure 38. Removing the Battery Door

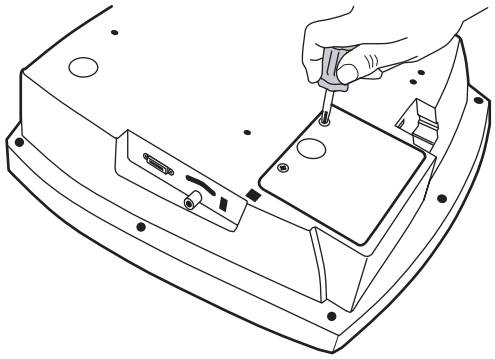
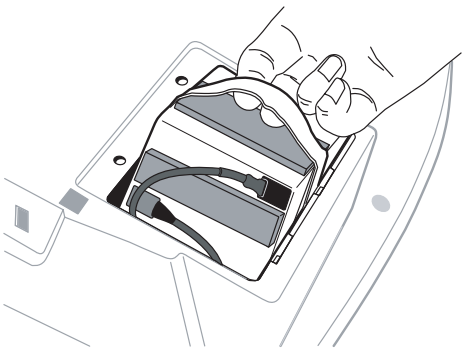
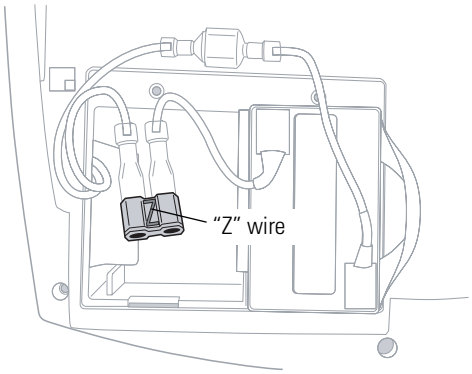


Figure 39. Lifting Out the Battery



5. Inspect the fuse. See Figure 40.
   - If the "Z" wire is intact, go to Step 6.
   - If the "Z" wire is broken or dark, replace the fuse. See "Replacing the Battery (DC) Fuse" on page 63.

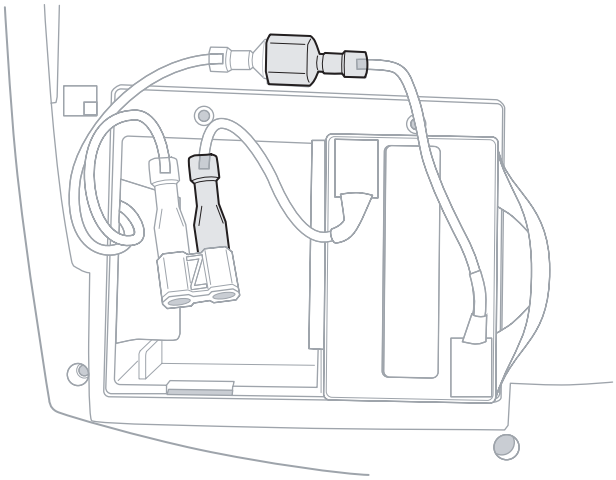
Figure 40. Battery Fuse Plugged In



6. Unplug the two battery connectors. See Figure 41.

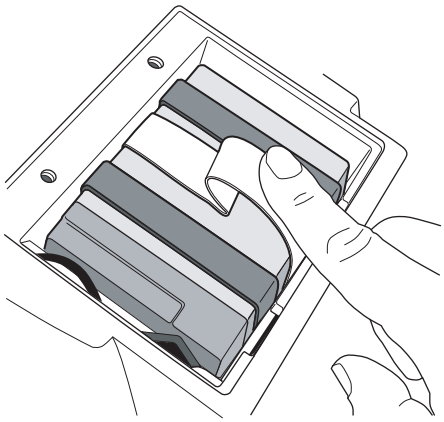
   You may need to pull hard. Use pliers gently if necessary.

Figure 41. Battery Connectors



7. Connect a new battery by matching connector sizes. Do not force connectors to mismatch.
8. Carefully tuck in all cables. Place the battery into the battery compartment. Fold the strap so that it will not stick out when you replace the battery door. See Figure 42.

Figure 42. Folding the Battery Strap



9. Replace the battery door and screws. Turn the electrocardiograph rightside-up.

   It turns on automatically and displays a prompt to enter date and time.

10. Enter the date and time.

    The electrocardiograph is ready to use.

11. Discard the old battery appropriately.

    - In the USA, call 1-800-SAV-LEAD for instructions on how to recycle it.
    - International users, contact your local authorities concerning recycling.

Replacing the Battery (DC) Fuse

If the battery (DC) fuse requires replacing, as described in Step 5 on page 61, follow these steps. For the fuse value, see "Fuses" on page 73.

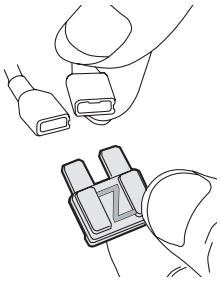
1. Remove and discard the fuse. See Figure 43.

   You may need to pull hard. Use pliers gently if necessary.

2. Connect a new fuse. It goes in either way.

3. Go to Step 8 on page 62.

Figure 43. Battery Fuse Removed



Replacing the AC Fuses

If the green LED on the keyboard does not light up when the electrocardiograph is connected to AC power, you may need to replace one or both of the AC fuses, as follows. For the fuse value, see "Fuses" on page 73.

1. Unplug the electrocardiograph from AC power if connected.

   WARNING Failure to unplug could result in electrocution.

2. Use needle-nosed pliers to remove the fuse case. See Figure 44.
3. Inspect the fuses. If either fuse is dark or has a broken wire, replace the fuse. See Figure 45.
4. Insert the fuse case. Line it up with the opening; it goes in only one way.

Figure 44. Removing AC Fuse Case

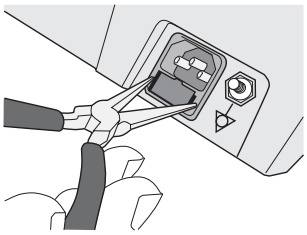
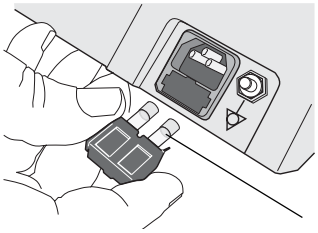


Figure 45. AC Fuses Removed



Storing the Equipment

When storing the electrocardiograph, cords, and accessories, observe the environmental storage conditions. See "Specifications" on page 73.

Discarding the Equipment

Discard the old battery appropriately.

- In the USA, call 1-800-SAV-LEAD for instructions on recycling it.
- International users, contact your local authorities concerning recycling.

Discard the electrocardiograph, cords, and accessories according to local laws.

Do not dispose of this product as unsorted municipal waste. Prepare this product for reuse or separate collection as specified by Directive 2002/96/EC of the European Parliament and the Council of the European Union on Waste Electronic and Electrical Equipment (WEEE). If this product is contaminated, this directive does not apply. For more specific disposal information, see www.welchallyn.com/weee, or contact Welch Allyn Customer Service at +44 207 365 6780.

7 Troubleshooting

Problem-Solving Suggestions

This section includes several tables:

- Lead quality problems (Table 2 on page 68)
- System failure problems (Table 3 on page 69)
- System messages (Table 4 on page 70)

If you try these suggestions and still have problems, contact Technical Support. For phone numbers, see page ii.

Table 2. Lead Quality Problems

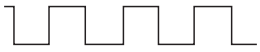
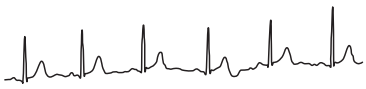
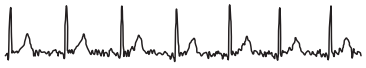
Condition	Causes	Actions
A dot is flashing on the **Lead Status** screen. OR Lead-off information is displayed on the screen. OR One or more leads prints as a square wave: 	• Electrode contact may be poor. • A lead may be loose. Note: Square waves may indicate that the electrocardiograph is inoperative, but they are more likely to indicate loose leads.	• Reattach the lead. • Replace the electrode. • Verify that the electrode area has been properly prepared: shaved, cleaned with alcohol or acetone, allowed to dry. • Verify that electrodes have been properly stored and handled.
Wandering baseline (an upward and downward fluctuation of the waveforms): 	• Electrodes that are dirty, corroded, loose, or positioned on a bony area. • Insufficient or dried electrode gel. • Oily skin or body lotions. • Rising and falling of chest during rapid or apprehensive breathing.	• Clean skin with alcohol or acetone. • Reposition or replace electrodes. • Help patient relax. • If wandering baseline persists, turn the baseline filter on. See "Adjust Baseline Filter" on page 55.
Muscle tremor interference (random, irregular voltage superimposed on the waveforms). May resemble or coincide with AC interference: 	• Patient is uncomfortable, tense, nervous. • Patient is cold and shivering. • Exam bed is too narrow or short to comfortably support arms and legs. • Arm or leg electrode straps are too tight.	• Help patient get comfortable. • Check all electrode contacts. • If interference persists, turn the muscle-tremor filter on. See "Adjust Muscle Filter" on page 55. • If interference still persists, the problem is probably electrical in nature. See the following suggestions for reducing AC interference.

Table 2. Lead Quality Problems (Continued)

Condition	Causes	Actions
AC interference (even-peaked, regular voltage superimposed on the waveforms). May resemble or coincide with muscle-tremor interference.	• Electrodes that are dirty, corroded, loose, or positioned on a bony area. • Insufficient or dried electrode gel. • Patient or technician touching an electrode during recording. • Patient touching any metal parts of an exam table or bed. • Broken lead wire, patient cable, or power cord. • Electrical devices in the immediate area, lighting, concealed wiring in walls or floors. • Improperly grounded electrical outlet. • Incorrect AC filter frequency setting or AC filter is turned off.	• Check all electrode contacts and lead wires. • Verify that the patient is not touching any metal. • Verify that the AC power cable is not touching the patient lead cable. • Verify that the proper AC filter is selected. See "Mains Filter" on page 40. • If interference persists, unplug the electrocardiograph from AC power and run it on the battery. If this solves the problem, you'll know that the noise was introduced through the power line. • If interference still persists, the noise may be caused by other equipment in the room or by poorly grounded power lines. Try moving to another room.

Table 3. System Failure Problems

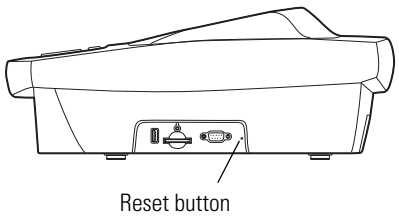
Condition	Causes	Actions
Won't turn on when plugged into AC power.	• Faulty AC power connection. • Blown AC fuses. • No AC power.	• Check the AC power source. • Check the AC fuses. See "Replacing the AC Fuses" on page 64.
Won't turn on when unplugged from AC power.	• Battery disconnected or incorrectly connected. • Battery low, not charging, depleted, or bad. • Blown battery fuse.	• Check battery connections. See "Replacing the Battery" on page 61. • Recharge the battery. See "Recharging a Fully Discharged Battery" on page 60. • Replace battery. See "Replacing the Battery" on page 61. • Replace battery fuse. See "Replacing the Battery (DC) Fuse" on page 63.
Shuts down during printing	Battery low or bad.	• Recharge the battery. See "Recharging a Fully Discharged Battery" on page 60. • Replace battery. See "Replacing the Battery" on page 61.
Prints fewer than 10 reports on a full battery charge.	Degraded battery.	Replace battery. See "Replacing the Battery" on page 61.
Unresponsive for an extended time.	System frozen.	Press the reset button by inserting a small object, such as a paper clip, into the hole.  Reset button
The screen is too dark or too light.	The contrast is to high or too low.	Press Ctrl-R. The contrast resets to its default value.

Table 4. System Messages (alphabetical order)

System Message	Problems	Actions
"Insufficient battery power to begin. Please connect AC power and try again."	Battery low or bad.	• Recharge the battery. See "Recharging a Fully Discharged Battery" on page 60. • Replace battery. See "Replacing the Battery" on page 61.
"Insufficient space available"	Not enough space on memory card or removable USB storage device.	• Delete some tests from the card or USB storage device at a PC. • Use a different card or USB storage device.
"Memory card error"	Problem writing to memory card or removable USB storage device.	• Verify that the write-protect tab is in the unprotected position. • Reseat the card in its slot. • Use a different card or USB storage device.
"Out Of Paper"	• Printer is out of paper. • Printer door is open.	• Load paper. See "Loading the Thermal Chart Paper" on page 21. • Close the printer door. See "Loading the Thermal Chart Paper" on page 21.
"Paper Jam"	Paper was loaded incorrectly.	Reload the paper. See "Loading the Thermal Chart Paper" on page 21.
"Powering down"	Low battery.	Recharge the battery. See "Recharging a Fully Discharged Battery" on page 60.
"Problem loading the following settings: <System> <ECG> * * * Using default settings."	Problem loading your settings at startup. May indicate memory problems.	Contact Technical Support. For phone numbers, see page ii.
"Shutdown?"	 was pressed while printing a Rhythm ECG.	To shut down, press  . To cancel the shutdown, press  .
"Temperature Error"	Printer head temp is too high.	Allow to cool, then try again.

Limited Warranty

Welch Allyn, Inc., warrants that the Cardiopulmonary line of electrocardiographs, including the CP 100 and CP 200 models (the Products) meet the labeled specifications of the Products and will be free from defects in materials and workmanship that occur within 3 years after the date of purchase, except that accessories used with the Products are warranted for 90 days after the date of purchase. Such accessories include: lead wires, cabling, electrodes, and battery.

The date of purchase is: 1) the date specified in our records, if you purchased the Product directly from us, 2) the date specified in the warranty registration card that we ask you to send to us, or 3) if you don't return the warranty registration card, 30 days after the date on which the Product was sold to the dealer from whom you bought the Product, as documented in our records.

This warranty does not cover damage caused by: 1) handling during shipping, 2) use or maintenance contrary to labeled instructions, 3) alteration or repair by anyone not authorized by Welch Allyn, and 4) accidents.

If a Product or accessory covered by this warranty is determined to be defective because of defective materials, components, or workmanship, and the warranty claim is made within the warranty period described above, Welch Allyn will, at its discretion, repair or replace the defective Product or accessory free of charge. If your Product requires repairs covered by this warranty, upon your request Welch Allyn will loan to you, at no cost, a substitute Product for use until your repaired Product is returned.

You must obtain a return authorization from Welch Allyn to return your Product before you send it to Welch Allyn's designated service center for repair. Contact Welch Allyn Technical Support. For phone numbers, see page ii.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILTY AND FITNESS FOR A PARTICULAR PURPOSE. WELCH ALLYN'S OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF PRODUCTS CONTAINING A DEFECT. WELCH ALLYN IS NOT RESPONSIBLE FOR ANY INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM A PRODUCT DEFECT COVERED BY THE WARRANTY.

Service Policy

All repairs on products under warranty must be performed or approved by Welch Allyn. Unauthorized repairs will void the warranty. In addition, whether or not covered under warranty, any product repair shall exclusively be performed by Welch Allyn certified service personnel.

If the product fails to function properly—or if you need assistance, service, or spare parts—contact the nearest Welch Allyn Technical Support Center. For phone numbers, see page ii.

Before contacting Welch Allyn, try to duplicate the problem, and check all accessories to ensure that they are not causing the problem. When calling, please be prepared to provide:

- Product name and model number and complete description of the problem.
- Serial number of your product (if applicable).
- Complete name, address and phone number of your facility.
- For out-of-warranty repairs or spare parts orders, a purchase order (or credit card) number.
- For parts orders, the required spare or replacement part numbers.

If your product requires warranty, extended warranty, or non-warranty repair service, please call first the nearest Welch Allyn Technical Support Center. A representative will assist you troubleshooting the problem and will make every effort to solve it over the phone, avoiding potential unnecessary returns.

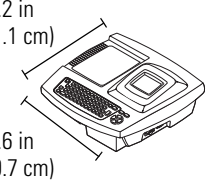
In case a return cannot be avoided, the representative will record all necessary information and will provide a Return Material Authorization (RMA) number, as well as the appropriate return address. An RMA number must be obtained prior to any return.

If you have to return goods for service, follow these recommended packing instructions:

- Remove all hoses, cables, sensors, power cords, and ancillary products (as appropriate) before packing, unless you suspect they are associated with the problem.
- Wherever possible use the original shipping carton and packing materials.
- Include a packing list and the Welch Allyn Return Material Authorization (RMA) number.

It is recommended that all returned goods be insured. Claims for loss or damage to the product must be initiated by the sender.

A Specifications

Item	Specification
Dimensions	16.2 in (41.1 cm)  6.2 in (15.7 cm) 15.6 in (39.7 cm)
Weight	11.6 lb (5.3 kg)
Keyboard type	Elastomer keypad with complete alphanumeric keys
Paper type	8.25 x 11 inches (21 x 28 cm), Z-fold thermal paper, 200 sheets
Thermal printer (internal)	Computer-controlled dot array, 8 dots/mm
USB printer (external)	Inkjet or laser printer that supports PCL (printer control language)
Thermal paper speeds	10, 25, 50 mm/s
Gain settings: Auto ECGs Rhythm ECGs	 5, 10, 20 mm/mV, AUTO 5, 10, 20 mm/mV
Report print formats: Auto ECGs Rhythm ECGs Average cycles	 3x4, 3x4+ 1R, 3x4 +3R, 6x2, 12x1, 6x2 50 mm/s, 6x2 Ext., 2x6 +1R, 6x2 +1R 3 leads at a time 3x4 50 mm/s + 3R, 6x2 50 mm/s + 6R
Frequency range	0.3 to 150 Hz
Digital sampling rate	> 1,000 samples/second/channel
Pacemaker detection	ANSI/AAMI EC11
Power requirement	Universal AC power supply 100–240 V ~, 50/60 Hz ~, 2.2 A maximum
Fuses AC DC (battery fuse)	 Time-delay type, 2 amp 250 V rating, Littlefuse 0215002 or equivalent. Fast-acting type, 10 amp 32 V rating, Bussman ATC-10 or equivalent.
Lead configurations	Standard, Cabrera
Rechargeable battery	Lead acid gel, 6 volt, 5 AH Prints up to 100 continuous ECGs per charge 12-hour recharging

Item (Continued)	**Specification (Continued)**	
Filters	0.5 Hz high-performance baseline filter 35 Hz muscle-tremor filter AC-interference filter 50 Hz or 60 Hz	
Safety, EMC, and regulatory compliance	ANSI/AAMI EC11* CAN/CSA C22.2 No. 601.1 CAN/CSA C22.2 No. 601.1.1 CAN/CSA C22.2 No. 601.1.2 CAN/CSA C22.2 No. 601.1.4 CAN/CSA C22.2 No. 601.2.25 CAN/CSA C22.2 No. 601.2.51	UL60601-1 IEC/EN 60601-1 IEC/EN 60601-1-1 IEC/EN 60601-1-2 IEC/EN 60601-1-4 IEC/EN 60601-2-25 IEC/EN 60601-2-51
Standard connectivity	Com port for USB cables or removable USB storage devices (≥ 64 MB, < 2 GB) SD memory card slot (for use with cards ≥ 64 MB, < 2 GB)	
Connectivity with electronic medical records	Supported through the Welch Allyn CardioPerfect workstation software	
Electrodes	Rigorously tested for conductivity, adhesion, and hypoallergenic qualities, and exceed all AAMI standards	
Cables and wires	Meet or exceed IEC 60601	
Environmental operating conditions:		
Temperature	+10° C to +40° C (+50° F to +104° F)	
Relative humidity	15 – 95% noncondensing	
Altitude	700 – 1060 hPa	
Environmental storage conditions:		
Temperature	-20° C to +49° C (-4° F to +120° F)	
Relative humidity	15 – 95% noncondensing (30 – 70% for printing)	
Altitude	500 – 1060 hPa	
Protection against electric shock	Class I, internally powered Type CF	
Protection against ingress of water, per IEC 60529	IPX0	
Mode of operation	Continuous	

*Per AAMI EC11:1991/(R)2001 Diagnostic Electrocardiographic Devices, Section 3.1.2.1 Disclosure of cautionary information/ performance characteristics paragraph c) Accuracy of input signal reproduction, the manufacturer shall disclose the methods used to establish overall system error and frequency response. Welch Allyn has used methods A & D, as prescribed in section 3.2.7.2 and 4.2.7.2 of this same standard, to verify overall system error and frequency response. Because of the sampling characteristics and the asynchronism between sample rate and signal rate, digital ECG systems such as the CP 100 and CP 200 may produce a noticeable modulating effect from one cycle to the next, particularly in pediatric recordings. This phenomenon is not physiologic.

Specifications are subject to change without notice.

B EMC Guidance and Manufacturer's Declarations

Table 5. Electromagnetic Emissions

The CP 100 electrocardiograph is intended for use in the electromagnetic environment specified below. The customer or user of the CP 100 electrocardiograph should assure that it is used in such an environment.

Emissions Test	Compliance	Electromagnetic Environment - Guidance
RF emissions CISPR 11	Group 1	The CP 100 electrocardiograph uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The CP 100 electrocardiograph is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Complies	

Table 6. Electromagnetic Immunity

The CP 100 electrocardiograph is intended for use in the electromagnetic environment specified below. The customer or user of the CP 100 electrocardiograph should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/ burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines Not applicable	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines. IEC 61000-4-11	>95% dip in 0.5 cycle 60% dip in 5 cycles 30% dip for 25 cycles >95% dip in 5 seconds	>95% dip in 0.5 cycle 60% dip in 5 cycles 30% dip for 25 cycles >95% dip in 5 seconds	Mains power quality should be that of a typical commercial or hospital environment. If the user of the CP 100 electrocardiograph requires continued operation during power mains interruptions, it is recommended that the CP 100 electrocardiograph be powered from an uninterruptible power supply or battery.
Power frequency (50/60Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Table 7. Electromagnetic Immunity

The CP 100 electrocardiograph is intended for use in the electromagnetic environment specified below. The customer or user of the CP 100 electrocardiograph should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment - Guidance
			Portable and mobile RF communications equipment should be used no closer to any part of the CP 100 electrocardiograph, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	$d = (1.17)\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = (1.17)\sqrt{P}$ 80 MHz to 800 MHz $d = (2.33)\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol: 

Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the CP 100 electrocardiograph is used exceeds the applicable RF compliance level above, the electrocardiograph should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the electrocardiograph.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Table 8. Recommended Separation Distances Between Portable and Mobile RF Communications Equipment and the CP 100 Electrocardiograph

The CP 100 electrocardiograph is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the CP 100 electrocardiograph can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the CP 100 electrocardiograph as recommended below, according to the maximum output power of the communications equipment.

	Separation Distance According to Frequency of Transmitter (m)		
Rated Max. Output Power of Transmitter (W)	**150 kHz to 80 MHz** $d = (1.17)\sqrt{P}$	**80 MHz to 800 MHz** $d = (1.17)\sqrt{P}$	**800 MHz to 2.5 GHz** $d = (2.33)\sqrt{P}$
0.01	0.117	0.117	0.233
0.1	0.37	0.37	0.74
1	1.17	1.17	2.33
10	3.70	3.70	7.37
100	11.70	11.70	23.30

For transmitters rated at a maximum output power not listed above, the recommended separation distance *d* in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Glossary

AHA. An abbreviation for *American Heart Association*. The AHA electrode labeling scheme is most commonly used in the United States.

Auto ECG. A report typically showing a 10-second acquisition of 12 leads of ECG information combined with patient data, interpretation, and measurements matrix. See also Rhythm ECG.

average cycles. Dominant waveforms for all 12 leads. Printed on a separate page, if enabled.

CardioPerfect workstation. A PC using Welch Allyn CardioPerfect software. Stores ECG and spirometry test data. Can communicate with other electronic patient-information systems, such as billing and medical records.

confirmed, unconfirmed. Status of an Auto ECG report's interpretation. Indicates whether the report has been reviewed and accepted by a qualified physician.

electrocardiogram (ECG). A record of the electrical currents associated with heart muscle activity. Sometimes called *EKG* for the German term, *Elektrokardiogramm*. See also Auto ECG; Rhythm ECG.

electrocardiograph. An instrument used to create electrocardiograms (ECGs).

extended measurements. Values for several common parameters, such as Q, R, and S amplitude and ST values. The amplitudes are expressed in microvolts. The durations are expressed in milliseconds. The measurements cannot be edited. Printed on a separate page, if enabled.

IEC. An abbreviation for *International Electrotechnical Commission.* The IEC electrode labeling scheme is most commonly used in Europe.

lead. (1) An electrocardiograph wire connected to an electrode, which is attached to a patient's skin. There are 10 lead wires. (2) A waveform that represents ECG data from a particular view of the heart. The data from the 10 lead wires is converted into 12 waveforms, also called leads: I, II, III, aVR, etc.

MEANS. An acronym for *modular ECG analysis system*. The optional MEANS interpretation algorithm, developed by the University of Rotterdam, Netherlands, provides automatic analysis of ECG tests. Also available in pediatric version: PEDMEANS.

PEDMEANS. See MEANS.

Power-Save. A user-selectable feature that automatically turns the electrocardiograph off after several idle minutes.

Rhythm ECG. A continuous, real-time printout of ECG data. See also Auto ECG.

workstation. See CardioPerfect workstation.

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